DOCUMENT RESUME

ED 032 391 VT 007 585

Technology and Manpower in the Textile Industry of the 1970's. Bulletin No. 1578.
Bureau of Labor Statistics (Dept. of Labor), Washington, D.C.
Pub Date Aug 68
Note-87p.
Available from-Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402 (L2.3:1578, $.60)
EDRS Price MF-$0.50 HC Not Available from EDRS.
Descriptors-*Automation, Employment Projections, *Employment Trends, Evaluation, *Industry, Manpower Development, Manpower Needs, Negro Employment, Occupational Information, *Productivity, *Technological Advancement, Unemployment, Work Environment, Working Women
Identifiers-*Textile Industry

This bulletin describes changes in technology in the textile industry, one of the major industries of the economy, projects their impact on productivity, employment, and occupational requirements, and discusses methods of adjustment. It is designed to partially meet the requirement of the Manpower Development and Training Act that the Secretary of Labor "evaluate the impact of and benefits and problems created by automation, technical progress, and other changes in the structure of production and demand on the use of the nation's human resources; establish techniques and methods of detecting in advance the potential impact of such developments...." The focus of this study includes the following topics: trends toward modernization, technology in the 1970's, shift to manmades, potential for technological advance, production prospects, imports increase, employment and unemployment outlook, women in textile mills, outlook for Negro employment, more patrolling and monitoring, implications for education and training, and adjustments to technological change. (CH)

ED032391

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TECHNOLOGY and MANPOWER in the TEXTILE INDUSTRY of the 1970's

Bulletin No. 1578
AUGUST 1968

VT007585

UNITED STATES DEPARTMENT OF LABOR Willard Wirtz, Secretary
BUREAU OF LABOR STATISTICS Arthur M. Ross, Commissioner

For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C., 20402 – Price 60 cents

Preface

This bulletin describes changes in technology in the textile industry, one of the major industries of the economy, projects their impact on productivity, employment, occupational requirements, and discusses methods of adjustment. It is one of a series of reports designed to help meet the requirement of the Manpower Development and Training Act that the Secretary of Labor "evaluate the impact of and benefits and problems created by automation, technological progress and other changes in the structure of production and demand on the use of the Nation's human resources; establish techniques and methods of detecting in advance the potential impact of such developments;....."

The study was based on information obtained from Bureau and other government sources, trade and technical publications, discussions with company, union, and government officials, and textile equipment manufacturers, and attendance at conferences and exhibits. The Bureau of Labor Statistics is deeply grateful to many individuals who furnished valuable information and reviewed and commented on the draft of this report. Special acknowledgement for photographs is due Saco-Lowell Shops, Draper Corporation, M. Lowenstein & Sons, Leesona Corporation, and the American Textile Machinery Association.

The bulletin was prepared by Rose N. Zeisel in the Bureau's Office of Productivity, Technology and Economic Growth, under the supervision of Edgar Weinberg, Deputy Assistant Commissioner. The study is part of the Bureau's research program on productivity, technology, and economic growth under the general supervision of Jerome A. Mark, Assistant Commissioner.

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Summary and Highlights

Technological and economic developments in the textile industry have far-reaching implications for the utilization and adjustment of manpower. This bulletin surveys these changes, analyzes their impact on employment, manpower utilization, skill and occupational requirements in the 1970's, and discusses provisions for manpower adjustments.

Trend Toward Modernization

Interest in modernization of machinery, managment, and marketing is being stimulated by domestic and foreign competition and sustained by the relatively high profit rates of the past few years and the emergence of large vertically-integrated companies. Substantial investment in new plant and equipment is reducing technical obsolescence, and this trend is expected to continue. The leaders in these changes, however, are the larger, financially-able companies; thousands of small companies are only moderately involved in modernization. High cost mills will remain sensitive to increasing competition from more efficient producers.

Technology in the 1970's

Technological changes in the next decade will include wide-scale adoption of important modifications to conventional machinery, in some instances, the first advances in 50 years. Basically these changes comprise faster, larger capacity and more automatic machinery, and improvements in auxiliary equipment, such as automatic machine cleaning and materials-handling equipment. More radical changes, such as the combination or elimination of certain operations, computer process control in finishing, and new types of fabric formation will also affect textile production in the next decade, but their adoption is likely to be more gradual and, in some instances, limited.

Shift to Manmades

Manmade fibers, the result of intensive research by the chemical industry, influence every facet of the textile industry. Manmades, primarily synthetic noncellulosic fiber (nylon, polyester, etc.), accounted for more than half of all mill fiber consumption in 1966 (cotton equivalent basis). Advantages to the processor can include lower unit labor requirements and shorter processing time for some fibers, relatively stable prices, and less waste. By 1975, manmade fibers may constitute two-thirds of mill fiber consumption (cotton equivalent basis) in spite of stepped-up R&D for natural fibers.

Potential for Technological Advance

Quantitative indicators of various facets of technological change, such as output per man-hour and electric power and horsepower per worker, suggest a relatively high rate of advance in the postwar period. After World War II, wide-scale closing of marginal mills tended to raise the average level of technology in the industry; in recent years industry growth and high investment were major factors. Potential for a continued high rate of technological advance is suggested by the wide gap in "efficiency" between the "more efficient" mill or model mill and the average mill.

Production Prospects

Production increased slowly through most of the postwar period but moved up sharply in the 1960's, reflecting stronger demand for civilian and defense purposes. Wide variations exist among sectors. Wool textile output declined substantially in the postwar period; manmade fabrics, knit goods and carpets had rapid growth. A high growth rate is expected in the 1970's, but below the 1961-66 rate.

Imports Increase

The volume of imports, a strategic and uncertain factor in the outlook, has been increasing. The ratio of imports of cotton, wool and manmade fiber products (semi manufactured and manufactured) to domestic fiber consumption (measured in pounds of fiber) rose sharply in 1966, after several years of relative stability. The import ration in 1966 was four times as large as in 1954. The multilateral Long Term Arrangement to provide for the orderly growth of cotton textile imports, in effect from 1962 to 1967, has been extended for a 3-year period. Wool and manmade textile imports are unregulated.

Employment and Unemployment Outlook

Although employment increased in the mid-1960's, projections for 1975 forsee a continuation of the long-term decline but at a much slower rate. Unemployment rates have fallen substantially in recent years, but rates in some areas, particularly New England, continue to be high. Some of the decline in employment may take place through the retirement of older workers and the transfer of workers to other industries. But the work-force will remain vulnerable to high unemployment rates as marginal plants with obsolete equipment are shutdown during short-term periods of slackening demand.

Women in Textile Mills

Almost half of all textile workers are women, and the proportion has been increasing slowly since 1940. Several technological innovations primarily affect women's occupations (in winding, drawing, and packaging), and will probably reduce job opportunities in these operations. On the other hand, as mechanization continues, new jobs may open to women which previously were considered physically too arduous for them. In general, women's job opportunities are closely related to the available male labor supply; women's largest employment gains occur during wartime or in periods of full employment.

Outlook for Negro Employment

Negro employment in the textile industry increased in the postwar period, in spite of substantial decreases in overall textile employment. In some Southern textile centers, however, the ratio of Negro employment remained fairly stable until the mid-1960's, when white male and female workers moved into generally higher paying jobs and Negroes were hired to meet demand created by turnover and expansion. Greater opportunities in other industries for white workers, the declining influence of isolated, socially-cohesive mill towns which tend to restrict Negro employment, and expanded efforts of the Equal Employment Opportunity Commission may continue to increase Negro gains. On the other hand, technological changes reducing unit labor requirements for unskilled workers may, in the long run, adversely affect opportunities for Negro workers.

More Patrolling and Monitoring

Further mechanization will continue to reduce the time allotted to traditional manual functions of loading, unloading, repairing, and machine-cleaning and to materials-handling functions of lifting, pushing and hauling. The textile operative of the 1970's will spend more time patrolling and monitoring a greater number of machines. Greater responsibility which is required for higher-speed and more fully integrated machinery may result in greater stress on the workers, although this may be offset by transfer of certain manual functions to the machine.

Occupational Trends Continue

Projections of the industry's occupational structure for 1975 expect that the bulk of textile employment, the semiskilled operative group (weavers, spinners, knitters, etc.) will continue to decline as a proportion of total employment. White-collar occupations will increase relative to the total by 1975, with professional and technical workers showing the greatest gains. Skilled worker requirements are also expected to increase relatively, while the proportion of laborers probably will decline significantly.

Implications for Education and Training

Technological advances do not require, in general, a long period of training or retraining except for a few skilled workers, such as loom fixers. Greater emphasis, however, is being placed on more formal training rather than on traditional on-the-job learning, and on slightly higher educational requirements for more skilled and supervisory jobs. Textile skills are not easily transferable to other industries, and in the event of layoff, retraining for new skills may be necessary.

Adjustments to Technological Change

Formal provisions for adjustment to technological change cover only a small proportion of the workers in the industry and are found primarily in plants with union agreements. Only about a fourth of all textile workers are in mills covered by collective bargaining agreements. Some contracts contain provisions which require advance notice, or union consultation, or a trial period for a proposed technological change. Contract provisions to financially assist the worker who is laid off are very limited. In the event of plant closings in some localities or sectors of the industry, government institutions for unemployment insurance, placement, and retraining can play an important role in assisting the textile worker.

Chapter I. Introduction: The Textile Industry's Place in the Economy

The textile mill products industry, one of America's oldest industries, employs over 900,000 workers or about 1 out of 20 manufacturing employees. One of the first to adopt power machinery, the industry has gone through various phases of rapid growth, stability, decline, and revival. This report deals primarily with postwar changes in the industry and the outlook for the 1970's.

At the end of World War II, the industry faced critical readjustment problems that brought about a severe contraction of employment lasting until 1963. Having been geared to peak wartime output and large postwar markets, the industry found itself in the 1950's with declining markets, excess capacity, obsolete equipment, and high unit costs. Many hundreds of high-cost mills, unable to compete in the smaller postwar market, closed, or merged with, or were acquired by financially stronger companies. Rising imports, low levels of production, prices, profits, and investment in plant and equipment, and sharply declining employment characterized the decade of the 1950's.

In the 1960's, the Federal government instituted several measures to assist the industry, including the 1962 Long Term Arrangement with leading textile nations to provide for the orderly growth of cotton textile imports over a 5-year period; more liberal depreciation allowances to encourage investment; elimination of the two-price cotton system 1/ which handicapped textile manufacturers; and an expanded program of government sponsored research. These provisions and subsequent favorable economic conditions of the 1960's created a climate for change in the industry which will be discussed in the following chapters.

This chapter briefly defines the industry, describes its relationship to other industries, and indicates its relative position in the domestic and international economy. It provides the background for subsequent chapters on technological prospects and their manpower implications.

Definition of the Industry

The industry comprises about 7,000 establishments engaged in the conversion of raw materials such as cotton, wool, and manmade fibers into yarn, thread, broad and narrow fabrics, knit goods, carpets and other miscellaneous products. Using the Standard Industrial Classification system, nine industry groups are distinguished. Of these, five relate to spinning and/or weaving mills: Cotton broadwoven fabric mills (SIC 221); man-

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1/ Under the government's program (originated to lower CCC holdings), raw cotton could be exported at 8-1/2 cents per pound below the domestic price. Foreign textile manufacturers could buy raw cotton at the lower price and sell the finished cloth in the United States.

made fiber and silk broadwoven fabric mills (SIC 222); wool broadwoven fabric and finishing mills (SIC 223); mills making narrow fabrics and other smallwares (SIC 224); and yarn and thread mills (SIC 228). These industries comprise about 2,200 establishments and more than half of the employees. A sixth group (SIC 225) comprises knitting mills (including hosiery and knit underwear, outerwear and fabric), totaling more than 2,800 establishments and one-quarter of all textile employees. Other groups include mills for dyeing and finishing textiles other than wool fabrics and knit goods (SIC 226); establishments producing woven or tufted floor coverings (SIC 227); and miscellaneous textile goods (SIC 229), including such items as felt goods, tire cord and fabric, and nonwovens.

Relationship to Other Industries

The textile mill products industry is affected by and, in turn, influences changes in industries from which it purchases materials and supplies, and to which it sells its output. The value of shipments in 1966 totalled $19.6 billion and total cost of materials $11.7 billion. Because of the large amount of purchases, even small proportions of the industry's total outlay can be significant to a supplier industry.

The bulk of the industry's purchases, about 45 percent in 1965 (latest data available), came from other sectors of the textile industry, a result of the vertical fragmentation of production. Purchases of raw cotton and wool made up about 11 percent of total purchases. Synthetic fiber constituted about 18 percent of total purchases made by the yarn and broadwoven sector, and about 34 percent of the purchases made by the carpet and miscellaneous textile sector. Purchases of chemical products used for processing fiber and fabric accounted for about 3 percent, and rubber and related products about 1 percent.

The increasing interdependence of the textile industry and the synthetic fiber industry is one of the most important and far-reaching developments. Large outlays for R & D and promotion have contributed to the rapid growth of synthetic fiber utilization. The textile industry purchases more than 35 percent of the output of the plastics and synthetics industry.

As a producer, the industry is heavily dependent on sales to the apparel and other consumer goods industries, and therefore, is affected by changes in disposable personal income. Over 80 percent of all fiber used in textile production in 1965 went for consumer uses (excluding tires): 41 percent for clothing; 29 percent for house furnishings; and 10 percent for other consumer type products, such as apparel linings. Industrial products, such as tires, sewing thread, rope, twine, and cordage took 17 percent of all fiber consumed in mills in 1965, a considerable decline from 24 percent for the years 1949-52. About 3 percent of fiber consumed in mills was exported in semi-fabricated or fabricated form, compared with 6 percent for the years 1949-52. (See table 1.)

Changing Competitive Position

The textile industry's relative domestic and international economic position declined markedly during the postwar period. National income originating in the industry in 1965 constituted 3.5 percent of income originating in all manufacturing as compared with 7.9 percent in 1947. In terms of employment, textile mills employed 5.0 percent of all manufacturing workers in 1966 compared with 8.4 percent in 1947.

Table 1. Textile Fiber End Use Consumption, 1949-52, 1957, and 1965

Type of end use	1949-52	1957	1965
	Millions of pounds		
Total	5,837	6,238	8,486
Clothing	2,328	2,559	3,484
Other consumer uses	586	655	875
Home furnishings	1,163	1,466	2,433
Industrial uses	1,405	1,210	1,440
Exports	355	348	254
	Percent of total		
Total	100.0	100.0	100.0
Clothing	39.9	41.0	41.1
Other consumer uses	10.0	10.5	10.3
Home furnishings	19.9	23.5	28.7
Industrial uses	24.1	19.4	17.0
Exports	6.1	5.6	3.0

NOTE: Because of rounding, sums of individual items may not equal totals.

SOURCE: Textile Economics Bureau.

Textiles have been confronted with increasing competition from paper and plastic materials, particularly for industrial uses. For example, the automobile industry, the largest industrial consumer for textiles, has been increasingly substituting plastic and foam rubber in place of textile fibers, reducing fiber poundage for car upholstery and slip covers about 20 percent from 1957 to 1965. Also, new types of paper are replacing fabric for bags and bagging, and for institutional use.

Relative to world textile production, the U.S. share of production declined significantly in the postwar period as capacity in war-torn and developing countries expanded. Recent studies indicate that the United States accounted for about 25 percent of total world production of textiles in 1953 compared with about 21 percent in 1966 which reflects some recovery in recent years. In 1950, U. S. cotton mill consumption constituted 31 percent of world mill consumption, in 1953, 23 percent and by 1965, it had declined to 19 percent. The growth of the synthetic fiber industry in other countries provides the basis for expansion of textile production. From 1955 to 1966, the U.S. share of noncellulosic fiber output declined from 65 percent to 38 percent of world production.

The recovery in world production ushered in a period of rising textile imports. (See table 2.) From 1954, when imports of semimanufactured and manufactured products constituted 2 percent of domestic consumption (cotton, wool and manmade fiber, measured in pounds), the import ratio rose almost steadily to 6.7 percent in 1962. The cotton import ratio was 1.2 percent in 1954, 7.2 percent in 1962; wool, 13.9 percent and 25.6 percent; manmade, 0.4 percent and 1.3 percent, respectively. These overall ratios reflect substantial variation among smaller sectors of the industry. For several sectors including ginghams, worsted fabrics, sweaters, gloves, velveteens and others, the import penetration was substantially and significantly greater.

Table 2. Imports of Semimanufactured and Manufactured Products of Cotton, Wool, and Manmade Fibers, Relative to Domestic Consumption, Selected Years

Year	All fibers[1]			Cotton		
	Domestic consumption[2]	Imports[3]	Imports as percent of domestic consumption	Domestic consumption[2]	Imports[3]	Imports as percent of domestic consumption
	Million of pounds			Million of pounds		
1940	4,726.9	64.1	1.4	3,822.6	43.2	1.1
1945	5,668.1	41.4	.7	4,248.7	25.2	.6
1954	5,742.0	114.4	2.0	3,885.6	48.5	1.2
1962	7,206.4	486.0	6.7	4,277.5	309.8	7.2
1964	7,938.0	491.4	6.2	4,331.4	300.2	6.9
1965	8,759.2	595.7	6.8	4,664.3	360.6	7.7
1966	9,407.7	756.4	8.0	4,938.8	495.9	10.0
	Wool[4]			Manmade		
1940	416.9	20.2	4.8	487.4	0.8	0.2
1945	604.6	15.5	2.6	814.8	.7	.1
1954	439.5	61.0	13.9	1,416.9	4.9	.4
1962	570.3	145.6	25.6	2,358.6	30.6	1.3
1964	490.8	141.1	28.8	3,115.8	50.0	1.6
1965	527.5	156.1	29.6	3,567.4	79.0	2.2
1966	500.5	142.9	28.6	3,968.4	117.6	3.0

[1] Cotton, wool, and manmade.

[2] Domestic consumption equals mill consumption plus imports minus exports of semimanufactured and manufactured products.

[3] Raw fiber equivalent.

[4] Apparel and carpet wool.

SOURCE: Department of Agriculture; Department of Commerce; and Textile Organon.

In 1962, following extensive congressional hearings on the industry's problems, the Long Term Arrangement (LTA) was negotiated with leading textile nations to regulate cotton textile imports for five years. Imports of wool and manmade fiber textiles were not regulated. After a relatively stable period from 1962 to 1964, cotton imports rose sharply in 1965 and 1966. Wool imports fluctuated only slightly in those years and in 1966 was at the 1962 import level. Manmade imports which account for about 16 percent of the total, rose steadily from 1962 to 1966 and most sharply in 1965 and 1966.

In total, imports of the three fibers remained fairly stable from 1962 to 1964 and then rose sharply in 1965 and 1966. Since domestic consumption increased from 1962 to 1964, the import ratio declined from 6.7 to 6.2 percent. In 1965 and 1966, however, imports rose substantially more than domestic consumption and the import ratio increased to 6.8 and 8.0 percent respectively. The cotton import ratio stood at 10 percent, wool at 28.6 percent and manmade fiber at 3 percent in 1966.

The changing pattern of textile imports and exports has resulted in a negative balance of trade in the three major fiber manufactures of about $600 million in 1966. For the first time, imports of manmade fiber manufactures exceeded exports (dollar value), and cotton imports were almost double our exports. The U.S. balance of trade for manufactures of all fibers in 1966 was a deficit of approximately $900 million.

In addition to increasing competition from other materials and from imports, interfiber competition, which will be discussed later in this study, further complicated the industry's problems.

Chapter II. Background of Technological Change

In order to understand technological and manpower developments in the industry, it is necessary to review some historical factors affecting the industry's efforts to modernize and to analyze current changes in organization, finances, investment, and research which will influence future trends.

Stages of Development

Technological innovation in the textile industry proceeded rapidly in the United States in the first half of the 19th century, after having been restricted by British embargoes on the export of textile machinery and skilled labor. The first modern textile factory in America incorporating all processes in one mill under one management was opened in Waltham, Massachusetts, in 1814. One of the most important technical developments of this period was Thorp's ring spinning system in 1828 which reduced greatly unit labor requirements for skilled labor. The textile industry was one of the major growth industries of the expanding American economy during the early 19th century.

A second phase of significant technical innovation and economic change occurred at the turn of the 20th century. Northrop's loom, the first major change since the power loom of 1785, ejected the empty bobbin and inserted a fresh bobbin automatically, greatly increasing productivity. One weaver could supervise as many as 16 looms instead of 2 looms and stops were reduced from 200 to 6 a day.

The Northrop loom appeared on the market when cotton textile mills were moving from the North to the South, and the new mills of the South adopted the loom fairly readily which resulted in strengthening their long-run competitive position. The Northern mills, however, did not modernize as rapidly. By 1914, over 40 percent of the Southern looms were automatic compared with 26 percent in the North. By 1929, the proportions had risen to 80 percent in the South but were only 59 percent in the North.

Innovations in the first half of the 20th century were limited, for the most part, to evolutionary modifications of existing textile machinery. The impact of any one technical change during those years tended to be small, although taken in the aggregate, they resulted in greater productivity. The changes in machinery, products and materials which occurred in the late 1950's and 1960's will be discussed in the next chapter.

Barriers to Technological Change

Textile producers have generally been conservative about major technological changes, tending to retain traditional methods of production. The pattern was to maintain machinery for the depreciation life of the machine, usually 30 years, although it was often outmoded in considerably less time. Although this conservative attitude dominated the industry in the past, the economic and structural factors underlying it appear to be changing.

One explanation of the industry's lack of innovation has been the high degree of vertical "fragmentation" of the business structure. Crucial steps in the industrial process of making textile products are divided among companies which are independent of one another. Thus, most textile mills are single unit, highly specialized operations, such as yarn mills, traditionally oriented to production of an intermediate product. Only about 40 percent of all cotton and synthetic broadwoven mills were integrated in 1958 (the latest data available)--i.e., they purchased raw material and processed it through weaving. Moreover, very few cotton and synthetic fiber broadwoven mills do their own finishing. Goods may be marketed by commission houses or independent selling agents. Most of the large mills are integrated, however. Although the independent mill manufacturing an intermediate product may have some advantages of flexibility, he may be handicapped by his lack of direct contact with and knowledge of the market for finished goods. This would tend to discourage change.

Relatively low profits of most mills in the postwar years have also been an important factor discouraging innovation. (See table 3.) Average textile corporate profits (after taxes) per dollar of sales and per dollar of stockholders' equity in the 1950's averaged about 50 percent of the rate for all manufacturing corporations. Moreover, textile producers tended to limit capital spending, on average, to internal funds (undistributed profits and depreciation allowances) which were not large enough in this period to permit expenditures much over the amount needed for maintenance of installed machinery and equipment.

Table 3. Corporate Sales and Profit Rates, Manufacturing and Textile Mill Products, 1947 and 1957-66

Year	Corporate sales, textile mill products (millions)	Percent of profits after taxes			
		On sales[1]		On stockholders' equity[1]	
		Manufacturing	Textile mills products	Manufacturing	Textile mills products
1947	$9,027	6.8	8.2	15.6	19.5
1957	13,056	4.8	1.9	11.0	4.2
1958	11,970	4.1	1.6	8.6	3.5
1959	13,762	4.8	3.0	10.4	7.6
1960	13,254	4.4	2.5	9.2	5.8
1961	13,398	4.3	2.1	8.8	5.0
1962	14,449	4.6	2.5	9.8	6.2
1963	15,092	4.7	2.3	10.2	6.0
1964	16,249	5.2	3.1	11.6	8.4
1965	18,028	5.6	3.8	13.0	10.8
1966	19,513	5.6	3.6	13.4	10.0

[1] Annual rate, average of quarterly profit rates.

SOURCE: Federal Trade Commission and Securities and Exchange Commission.

Finally, until recently, little attention was paid to developing new products and markets, and little market research or advertising was carried on. This reliance on existing managerial and entrepreneurial methods was reinforced in some companies by family ownership and management which tended to be conservative in instituting major changes.

New Directions

An improved financial position, competitive pressure to reduce unit costs, larger, more integrated units, and a favorable economic outlook set the stage in the 1960's for unprecedented interest in modernization. This is reflected in increased expenditures for plant and equipment and for research.

Trend toward larger business units. One of the most significant developments in the industry is the trend toward larger business organizations. Between 1955 and 1966, about 365 textile companies, according to the Federal Trade Commission, were acquired by other companies through mergers and acquisitions. Most of the acquiring companies were also in the textile industry. In some cases, the objective was diversification, such as one company's acquisition of hosiery and carpet mills; in others, the objective was greater vertical integration through acquisition of spinning mills and retail clothing outlets.

Mergers among textile companies also occurred in large numbers in the 1920's and 1930's, when small mills merged in an effort to offset the financial power and merchandising experience of the commission or selling house. In the 1940's, wartime pressure to expand facilities, coupled with material and machine shortages, again favored integration. Between 1940 and 1946, half the industry's spindle facilities were sold in vertical acquisitions.

The best available measure of the trend toward larger business organizations is the increasing proportion of the textile industry's output accounted for by the largest textile firms, although relative to many other industries, these ratios are still low. In the cotton broadwoven sector, the value of shipments by the four largest companies rose from 18 percent of this sector's total in 1954 to 30 percent in 1963. (See table 4.) In the synthetic broadwoven sector, the four largest companies increased their share of expanding total shipments from 30 percent in 1954 to 39 percent in 1963. In the knit underwear sector, the ratio rose from 26 percent to 33 percent (Census data).

There is, however, wide variation in concentration among the various textile sectors. Shipments of the four largest wool weaving firms accounted for over 50 percent of shipments in 1963; in the yarn sector, 17 percent; and in knit outerwear, only 11 percent.

Improved financial position. The industry's profit position improved in mid-1960 relative to the 1950's, although it is still considerably below the levels for all-manufacturing industries. In 1964-66, corporate profits (after taxes), as a percent of sales, averaged 3.5 percent compared with 2.6 percent in the 1950-59 period, and 2.4 percent in the 1960-63 period. Stockholders' equity as a percent of sales averaged 9.7 percent in 1964-66 compared with 5.8 percent in 1960-63. Preliminary estimates for 1967, however, indicate some cutback from recent high levels.

Profit ratios of the leading textile corporations have been, on the average, considerably higher than those of all corporate producers of textile mill products. In 1966, the average profit-sales ratio of the 4 leading (publicly owned) corporations (based on data from Textile Industries) was 39 percent higher, and of the 15 leading corporations was about a quarter higher, than the average profit ratio of all textile corporations. The ratio ranged widely for the 15 companies, from 2.1 percent to 7.2 percent.

Table 4. Value of Shipments Accounted for by the Largest Textile Companies, 1954 and 1963

(Percent of total shipments)

Selected industry sectors, and year[1]	4 largest	8 largest	20 largest	50 largest
Weaving mills, cotton:				
1954	18	29	49	(2)
1963	30	46	67	87
Weaving mills, synthetics:				
1954	30	39	55	(2)
1963	39	48	64	82
Weaving, finishing mills, wool:				
1963	51	58	71	85
Narrow fabric mills:				
1954	13	21	37	(2)
1963	20	30	47	68
Women's hosiery, except socks:				
1963	34	47	64	79
Hosiery, not elsewhere classified:				
1963	18	25	38	58
Knit outerwear mills:				
1954	6	10	20	(2)
1963	11	16	27	43
Knit underwear:				
1954	26	40	64	(2)
1963	33	52	73	93
Knit fabric mills:				
1954	17	29	51	(2)
1963	18	25	42	65
Finishing plants, cotton:				
1963	45	59	77	92
Finishing plants, synthetic:				
1963	31	44	61	81
Woven carpets and rugs:				
1963	67	88	98	99
Tufted carpets and rugs:				
1963	25	41	65	87
Yarn mills, except wool:				
1963	17	27	46	68
Thread mills:				
1954	66	78	92	(2)
1963	68	85	96	99

[1] Comparable data for some years are not available due to significant changes in the Standard Industrial Classification.

[2] Not available.

SOURCE: Bureau of the Census.

The increased availability of internal funds for investment is of major significance in the industry's efforts to modernize. Corporate internal funds, i.e., undistributed corporate profits and capital consumption allowances (depreciation charges and accidental damage to fixed capital) rose from an annual average of $420 million in 1950-59, to $695 million in 1960-66, a 65 percent rise. As shown in Chart 1, the rise in expenditures for new plant and equipment (corporate and noncorporate), in recent years, closely paralleled the increase in corporate internal funds. In 1965 and 1966, expenditures for plant and equipment exceeded the large internal funds, a reflection of the importance of modernization to the industry and the investors' confidence in the future.

Federal measures have contributed to creation of conditions favorable to large scale investment in new plant and equipment. The depreciation schedule of 1961 reduced the average depreciable life of textile machinery from 15-40 years to 12-15 years. Also, the textile industry, along with other industries, benefited from an investment tax credit on expenditures for new equipment which went into effect in 1962. After several months' suspension in the fall of 1966, it was reinstated in the spring of 1967.

Increasing expenditures for modernization. A sharp increase in expenditures for new plant and equipment in the past 5 years, following more than a decade of low investment, has provided opportunities for introduction of new technology. Expenditures for plant and equipment between 1962 and 1966 inclusive, totaled $ 4.1 billion, or an average of $ 820 million a year (OBE-SEC data) compared with an average annual of $430 million over the 1957-61 period. In 1966, total expenditures on new plant and equipment amounted to $ 1.13 billion (table 5).

Table 5. Expenditures for Plant and Equipment, Manufacturing and Textile Mill Products, 1947 and 1957-66

(Billions of dollars)

Year	Manufacturing	Textile mill products
1947	$8.70	$0.51
1957	15.96	.41
1958	11.43	.29
1959	12.07	.41
1960	14.48	.53
1961	13.68	.50
1962	14.68	.61
1963	15.69	.64
1964	18.58	.76
1965	22.45	.98
1966	26.99	1.13
	Average annual percent change	
1947-57	6.3	-2.2
1957-66	6.0	11.9

SOURCE: Department of Commerce and Securities and Exchange Commission.

It is important to recognize that the bulk of these expenditures were made by the larger textile companies. Establishments in multiplant companies, which constituted about one-fourth of all establishments in the industry in 1963, spent about three-fourths of total capital expenditures, according to Census data. 2/ (See table 6.)

The bulk of capital expenditures was for modernization and replacement, but since 1960, an increasing proportion has been spent for plant expansion. A considerably larger proportion is also being spent on "automated" machinery and equipment, 21 percent in

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2/ The Census Bureau estimates of capital expenditures differ from the joint Office of Business Economics-Securities and Exchange Commission data. In addition to sampling variations, Census data relate only to manufacturing establishments while OBE-SEC includes all establishments, manufacturing and nonmanufacturing of manufacturing companies.

Table 6. Percent Distribution of Establishments and Expenditures by Type of Company, 1963

Item	All	Multi-unit companies	Single unit companies
Total number of establishments	100.0	25.7	74.3
Capital expenditures	100.0	77.1	22.9

SOURCE: Bureau of the Census.

1966 (above the ratio for all manufacturing) compared with 14 percent in 1963. The capitalization ratio (investment per job) for mills built in 1966 has been estimated at approximately 20 percent greater than 5 years earlier and 40 percent greater than in 1956.

These expenditures increased capacity by 23 percent from 1962 to 1966 (see table 7) and updated the industry's facilities. According to a McGraw-Hill survey, the proportion of pre-1950 facilities declined from 49 percent in 1962 to 29 percent in 1966. The ratio of new capacity to total showed improvement. (See chart 2.) Plant and equipment, 5 years old or less, accounted for 38 percent of textile capacity in 1966 compared with 27 percent in 1962. The proportion of textile facilities of that age, in 1966, was slightly larger than the proportion of facilities of that age in all manufacturing.

Table 7. Operating Rate and Capacity Expansion, Textile Mill Products,[1] 1958-66

Year	Actual operating rate, December (percent)	Index of capacity December 1950=100
1958	87	116
1959	92	121
1960	82	122
1961	91	126
1962	92	129
1963	95	133
1964	96	137
1965	99	149
1966	94	159

[1] Represents primarily large companies.

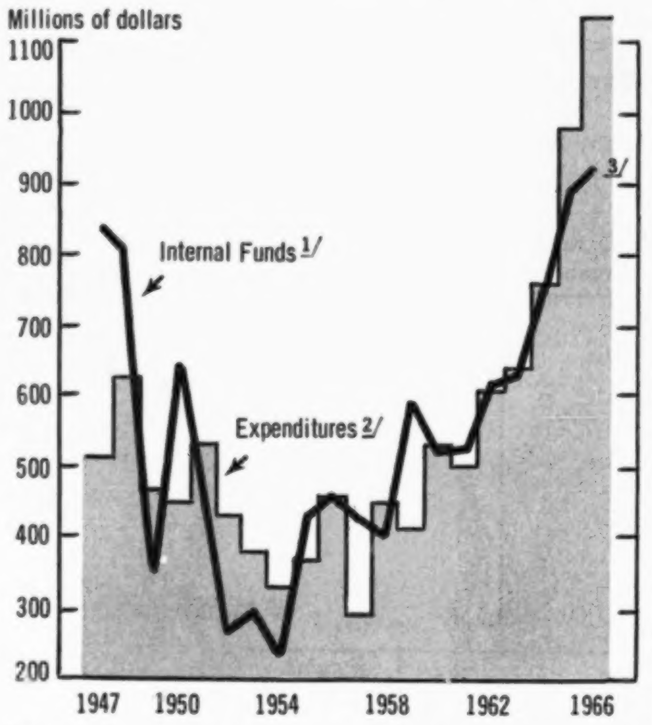
SOURCE: McGraw-Hill Publications, Economics Department.

The industry's facilities, however, continue to be the second oldest among manufacturing industries, just as they had been in 1962. Moreover, this survey covers only larger companies and the proportion of obsolete equipment still maintained by smaller companies is probably considerably greater, although a substantial proportion of old machinery has been rebuilt. Small and medium-sized companies may not have replaced their obsolete equipment as much as did large companies because of lack of financial resources and access to financial markets, or because of cost factors.

Expenditures for investment are expected to continue to be substantial in the next several years, but reductions from the 1966 peak are anticipated. Estimates for 1967 are about $880 million. Several factors are responsible, including the sizable capacity growth, the recent cutback from peak levels of production, and lower profit rates. The operating rate fell from 99 percent in December 1965 to 94 percent in 1966, as shown in table 7.

Growth of interest in research and development. Another important aspect of the textile industry's modernization movement is the increasing interest, especially on the part of large companies, in research and development of new products and processes. According to the National Science Foundation (table 8), R & D funds for textile and apparel firms totaled $38 million in 1965, about 0.5 percent of sales of companies engaged in R & D compared with $15 million in 1957. Outlays in 1966 are estimated at over $40 million. The paper and allied industry, by comparison, spent $76 million in 1965 which was about 0.7 percent of net sales of companies engaged in R & D. In all manufacturing, the percent of sales of companies engaged in R & D in 1965 was 4.3 percent.

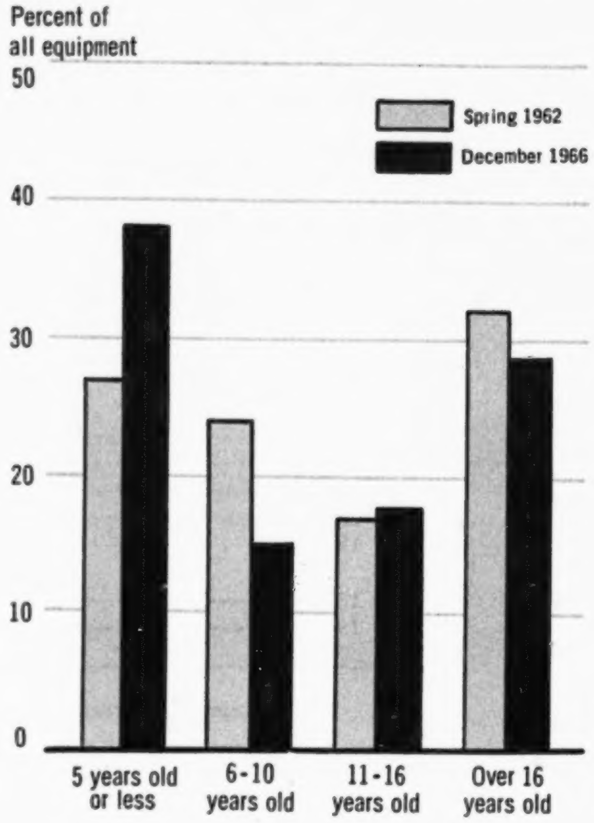
Chart 1. Corporate Internal Funds and Total Expenditures for Plant and Equipment 1947-66



1/ Undistributed corporate profits and corporate capital consumption allowances (depreciation charges and accidental damage to fixed capital).
2/ Corporate and noncorporate.
3/ Preliminary.

Note: See Appendix Table A-1 for data.

Chart 2. Age of Equipment of Large Textile Companies 1962, 1966



Note: See Appendix Table A-2 for data.

The major proportion of R&D funds are expended by relatively few large companies. Only 17 companies with employment of 5,000 or over accounted for 68 percent of all textile and apparel R&D funds in 1965. Thirty-four with 1,000-4,999 employees accounted for 23 percent of textile R&D funds. Although no data are available on the number of small companies (less than 1,000 employees) engaged in R&D, they accounted for only 9 percent of total textile R&D funds (table 9).

Viewed another way, the proportion of large companies doing R&D is greater than that for smaller companies, as would be expected. In 1963, 42 percent of textile and

Table 8. Research and Development Funds, Textile and Apparel Industries, 1957-66

Year	Total funds for R&D (millions)	Percent of net sales of companies performing R&D
1957	$15	(1)
1958	26	0.3
1959	30	.5
1960	38	.6
1961	30	.5
1962	28	.5
1963	30	.5
1964	32	.5
1965	38	.5
1966	42	(1)

[1] Not available.

SOURCE: National Science Foundation.

Table 9. Research and Development Funds, Textile and Apparel Companies, by Employment Size, 1958 and 1961-65

(Millions of dollars)

Year	Total	Employment size		
		5,000 and over	1,000 to 4,999	Less than 1,000
1958	$26	$16	$5	$4
1961	30	16	9	5
1962	28	13	12	3
1963	30	15	12	3
1964	32	21	8	3
1965	34	23	8	3

SOURCE: National Science Foundation.

apparel companies with 5,000 or more employees had R&D programs, compared with 24 percent of companies with 1,000-5,000 employees. Only a very small proportion of the many thousands of small companies, having less than 1,000 employees, spent funds for R&D.

The textile industry, however, draws heavily on research performed by its suppliers. The invention of nylon by a chemical firm in the 1930's exerted a profound influence on the textile industry and on the continuing involvement of the chemical industry in textile research. Outlays by the chemical industry for synthetic fiber research and development were estimated at $135 million in 1965, almost four times total textile and apparel funds for that year. Also, textile machinery manufacturers have been spending more heavily in recent years on basic and applied research. This has occurred in response to demand and to counteract imports of foreign machinery.

The Federal Government also carries on extensive research programs primarily to improve the marketability of natural fibers. However, relatively little Federal support is given to company R&D programs. Although Federal funds for R&D for the textile and apparel industry doubled from $1 million in 1957 to $2 million in 1964, they accounted for only 6 percent of total textile and apparel funds in 1964, compared with 16 percent for industrial chemicals (including synthetic fibers).

The rate of spending for R&D may increase significantly in the next several years, assuming the level of textile activity remains high. The growing number of large diversified corporations which have adequate financial resources to undertake long range research and development projects will continue to provide the major proportion of funds.

Chapter III. Technological Prospects in the 1970's

Technological changes taking place in the textile industry fall into 3 general types. One involves improvements of conventional machines (e.g. in speed, capacity, and automaticity), and installation of auxiliary equipment (e.g. for machine-cleaning and materials-handling) to increase productivity and improve product quality. Many of these have been adopted by larger modernized mills and are rapidly being adopted by smaller mills. Another line of development includes more radical changes, such as integration of two or more processes, advanced instrumentation, use of computers for data processing and finishing, and new methods of production which may require costly equipment, and in some cases, the building of a new mill. The third development is the increasing use of manmade fibers.

The changes discussed here are those now clearly seen as having significant impact in the next decade. Machinery and processes which are still in the developmental stage and may not have a substantial impact over the next ten years are mentioned, but are not discussed in detail.

Changes in Broadwoven Production

The technological developments described in detail below cover the major steps in cotton yarn and fabric manufacture. These operations are almost identical for manmade spun yarn and fabric manufacture, and roughly comparable with the woolen and worsted system of manufacture.

Production in a cotton cloth mill involves a long series of many discrete mechanical operations. Chart 3 indicates the flow of operations. Specialized machines at each stage reduce raw cotton to thread or yarn for weaving or knitting. After several successive operations, the yarn is woven into cloth. Finally the cloth is dyed and finished. These processes take place in specialized yarn, cloth, and finishing mills, or in fully integrated mills which include all processes from bale to finished cloth.

One of the major recent changes is the layout and design of the plant itself. Many of the 7,000 plants in the industry, built more than 25 years ago, are outdated multistory mills, poorly adapted to modern continuous flow methods. In the typical older mill, the work passes through several rooms located on different floors. Trucking and hauling materials from one operation to the next may comprise 5-15 percent of production costs. Lint-laden air is common in several rooms, and other plant conditions, such as lighting, may be inadequate in these older mills.

New mills usually have only one floor with few rooms, and machines are located close to each other in a line operation so that handling is minimized. Powered and pneumatic conveyors, hoists, and monorails also reduce materials handling in modernized mills, and lighten the workload of the mill operative. Air conditioning, cleaning and refrigeration, automatic machine-cleaning devices, and better lighting are becoming more widespread. Automatic waste systems collect waste from several operations and transport it to a central collection point which greatly reduces manual waste removal.

Chart 3.

Major Processes in an Integrated Cotton Broadwoven Mill

	Conventional Mills	Modernized Mills
OPENING-BLENDING	Several bales are manually plucked and fed into opening machines which loosen and partially clean the fiber. Then the fiber moves through blending machines to assure thorough mixing.	Fiber is mechanically fed into automatic opening-blending machines.
PICKING	Picker machines remove heavy impurities, parallelize the fiber, form it into sheets and roll the sheets into 60-90 pound packages called laps. The laps are manually removed and trucked to carding.	Laps are automatically removed and positioned at carding. In a few automatic systems, the picking operation is integrated with other processes, eliminating picker machines and lap formation. The fiber is chute-fed to carding.
CARDING	Carding machines rotate the lap over a surface of bent wires to clean, straighten, and parallelize the fiber into thin, rope-like strands called card sliver. The sliver is deposited into cans and manually trucked to drawing. Machines are cleaned manually.	Machines operate at four times the speed of ten years ago, have automatic cleaning devices, more instrumentation, and greatly reduced maintenance requirements. In automatic systems, the sliver is moved on a conveyor belt to drawing as part of a continuous system.
DRAWING	Drawing frames combine 6-8 fiber strands, draw or draft the fiber to increase parallelism and uniformity until the fiber is reduced to the size of a single strand in two processes of drawing. The sliver is deposited in cans, and trucked to roving. Machines are cleaned and lubricated manually.	Machines operate at six times the speed of ten years ago, have more instrumentation, automatic cleaning devices and considerably less maintenance.
ROVING	Roving machines reduce the drawing strands to much smaller strands, insert slight twist and wind the strands onto bobbins. The roving bobbins are manually removed (doffed), and trucked to spinning. Machines are cleaned manually.	Machines operate at considerably higher speeds, include more instrumentation and automatic cleaning. In one or two experimental mills, full bobbins are automaticallly doffed into spinning creels and moved to spinning frames. In some yarn mills, the roving process is eliminated, but this is not a new development.
SPINNING	Roving bobbins are manually loaded (creeled) on spinning frames which draw out the strands of fiber, twist them into yarn, and wind the yarn into small bobbins. The bobbins are manually doffed and trucked to next process. Machines are cleaned and lubricated manually.	New spinning frames are faster, make greater use of instrumentation and have automatic machine-cleaning and maintenance devices. In a few of the most advanced mills, full bobbins are doffed automatically. In some experimental mills, the spinning frames are creeled automatically.
WINDING AND WARPING	Winding and warping machines transfer filling and warp yarn from small spinning bobbins into larger packages for use on looms, knitting machines, etc. Machines are manually loaded.	Filling winding for use in shuttles is eliminated as a separate process in some mills and incorporated as an automatic attachment to the loom. Other winding machines are mechanically loaded and include greater use of instrumentation.
WEAVING	Looms interlace crosswise filling yarn (from bobbin in shuttle), and lengthwise warp yarn (from beam) to form cloth called grey goods. Almost half of all mill workers are employed in the weaveroom.	Loom speeds are 25-50 percent faster than new looms of 15 years ago. Centralized lubrication, automatic cleaning systems, and monitoring devices which record loom performance are incorporated in modern weaverooms. Suttleless looms maintained in some mills, operate at greater speeds, allow for a higher degree of automaticity, and may involve fewer preparatory processes.
FINISHING	Finishing involves a long series of discrete operations which may include singeing, desizing, bleaching, mercerizing, tentering, frequent drying, dyeing, printing, preshrinking, calendering, and special finishing processes.	Continuous systems and central controls are utilized in the most modern mills. At least one finishing mill has computer control of the dyeing process.

Opening and blending. In older systems, still used in many mills, a laborer lifts the cotton layer by layer from several bales, and feeds it into opening machines which loosen and partially clean the fiber. Then the cotton moves through blending machines to assure thorough mixing of the fibers.

Less than 5 percent of mill workers are employed in these operations. The work involves heavy lifting and handling of dirty materials; the workforce is unskilled.

Changes in the opening operation include faster and larger opening and blending systems, and mechanized materials-handling equipment which can reduce labor requirements per unit of output by about one-third. Heavy physical work is almost entirely eliminated with the use of these machines and auxiliary equipment, and the quality of the yarn improved through more efficient blending and cleaning.

Picking. Mechanical conveyors then move the cotton to picker machines which further remove heavy impurities, parallelize the fibers, form them into sheets, and roll the sheets into laps or large rolls. The picker machine operator (picker tender) removes (doffs) the roll from the picker machine, weighs it, and places it on a hand truck. A trucker moves it to the next machine. Men only are employed to operate the machines and to handle these heavy laps.

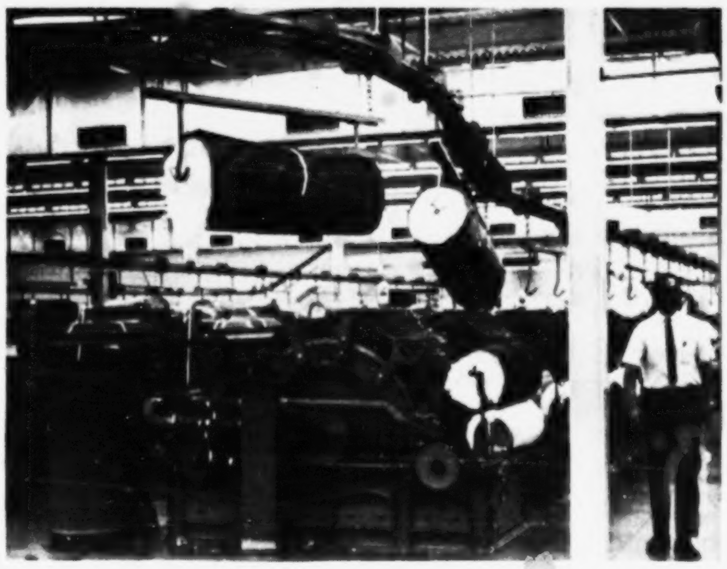
Picker operations have undergone significant changes in recent years, which reduce unit labor requirements. In many modernized mills, mechanized machine and floor-cleaning devices, including auxiliary suction tubes and lint shields, free the operator from time-consuming cleaning duties for more productive work. Also, the use of conveyors to move the lap roll to the next process eliminates the job of the unskilled trucker. In some mills, highly automatic conveyor systems pick up the roll, weigh it (reject it if it does not meet production requirements), move it, and position it at carding which is the next process. The machine operator intervenes only to start and stop the conveyors and to monitor for problems.

The most advanced continuous yarn system, first installed in Japan, integrates the picking process with the other prcesses, and eliminates conventional picker machines and the formation of the lap roll. The fiber, after cleaning and blending in specialized, highly automatic machines, is blown through pneumatic ducts directly to the carding machine for the next process. So far these systems have been installed in only two or three mills in the United States and are still in the experimental stage. Widespread adoption will be limited by the high cost; also, some of these machines cannot be easily integrated with generally used equipment.

Carding. Following opening and picking, the tangled bulky roll of fiber is moved to the carding operation where machines (cards) rotate it over a surface of bent wires to clean, straighten and parallelize the fiber into a thin rope-like strand (card sliver). The strand is precisely coiled into cans and manually trucked to the next operation.

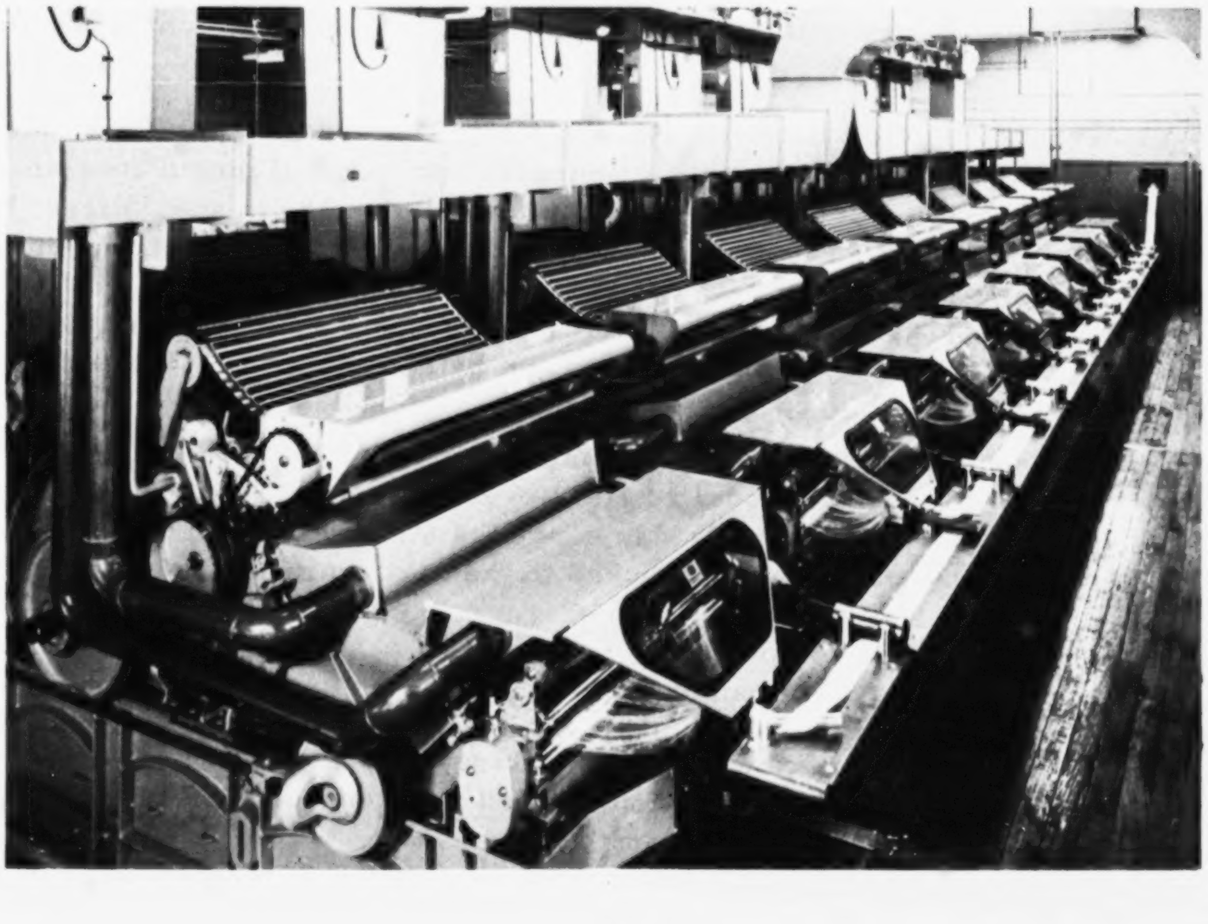
A few semiskilled machine operators (card tenders) tend a long line of carding machines. In the newer mills, one man may tend as many as 88 cards. The card tender moves constantly from machine to machine, feeding heavy lap rolls of fiber into the machine, doffing (removing) the full cans of sliver, piecing broken ends of fiber, and cleaning lint and waste from the cards. In addition, skilled maintenance workers (card fixers and card grinders) keep the mechanism in working order.

In most yarn mills, the fiber moves through opening, blending and picking operations, is wound into lap rolls and trucked to carding.



In this modern mill, mechanical transfer of lap rolls and automatic feed to carding machines replace manual handling. Then the fiber comes off each card into tall cans which are subsequently moved to the next process.

In this type of system, lap rolls may be eliminated. The fiber may be fed automatically into carding machines which are linked together and operate as a unit. Although less versatile, this system eliminates several steps, and requires less unit labor and less floor space.



Recent carding innovations greatly reduce the number of card tenders required per unit of output, and make obsolete the carding room of the 1950's. Modernized carding machines operate at more than four times the speed of only 10 years ago. They are equipped with stop-motion devices and larger doffing receptacles and can produce 40-50 pounds of fiber strand per hour compared with older card output of 10-15 pounds an hour. In addition, automatic suction devices on the carding machine at the points of discharge greatly reduce the tenders' cleaning tasks. Many mills are installing these devices because cards producing more than twice the output per hour of previous cards create considerably more lint and fly. In the newest mills, automatic overhead traveling vacuum cleaners are utilized in the card room. One new mill estimated that the tender's cleaning duties occupy 10-15 percent of his time instead of the 65 percent spent in older mills.

Maintenance downtime, i.e. the time the machine is not operating, and maintenance man-hours on carding machines are also being reduced significantly. Modernized carding machines eliminate an 8-hour card grinding process. Sealed bearings reduce oiling and card maintenance by the fixer. Also, automatic vacuum stripping (developed in 1957 but only now being widely adopted) permits the card tender or card stripper to oversee 3-4 times as many cards as was previously possible.

Although long-range forecasts predict the ultimate displacement of the carding operation by a radically new electro-static system, such developments are still in the research stage. New carding machines and auxiliary equipment described above are only beginning to gain industry acceptance, and will continue to be of major importance in mill modernization in the next decade.

Drawing. The next step in the textile plant is the drawing operation, where the fibers are further processed. Drawing frames combine 6 or 8 fiber strands, draw or draft the fibers to increase parallelism and uniformity until the fibers are reduced to the size of a single strand and are coiled into cans.

The drawing frame tender, a semiskilled operator, tends many rows of drawing frames. He repairs broken ends of sliver, replaces fiber receptacles, cleans the machine, and patrols the line of machines to detect malfunctioning. About one-fourth of all drawing frame tenders are women.

Faster machine speeds, automatic stop motions, automatic cleaning and conveying devices, and other drawing improvements can reduce unit man-hours by as much as 75 percent. The speed of new drawing frames, for example, is six times that of machines installed 10 years ago, and considerably fewer machines are needed for the same output. In the newest mills, only one drawing operator is required where 4-5 are necessary in an average mill for the same output. In addition, fewer maintenance men are required on modernized machines with antifriction bearings central lubrication. Roller bearings on new drawing frames require oiling once every 3 years during overhaul, compared with once a week on older models.

Roving. The roving machine reduces the drawing strand to a much smaller strand of fiber, inserts a slight twist, and winds the strands (roving) onto a bobbin. Bobbins are manually doffed and trucked to the next operation.

The ratio of workers on this operation is about 5 percent of mill employment. The semiskilled roving operator moves along the long line of roving machines, repairs or ties ends, doffs the bobbins, and cleans the machines. Tending roving machines has become primarily a man's job as larger and heavier packages of fiber must be loaded on and taken off the machine. Only about 10 percent of the tenders are women.

The newest models of the roving machine, with auxiliary stop-motion devices and cleaning systems, have significantly reduced downtime. Unit man-hours can be reduced by more than 75 percent. Moreover, the most advanced system includes automatic doffing. The roving bobbins are doffed into a spinning creel which is mechanically transferred to the spinning frame.

In some systems of yarn manufacture, primarily for use with coarse yarn, the roving process is omitted. This so-called sliver to yarn spinning is possibly the oldest solution to process elimination, and may be perfected for greater use at some future time.

Spinning. Spinning machinery for the final process in the manufacture of yarn draws out the strands of fiber, twists them into yarn, and winds the yarn onto small bobbins. When the bobbins are full, the frames stop automatically, and the bobbins are manually doffed (removed) and replaced by empty ones.

Workers in the average spinning room constitute about 20 percent of all mill operators. Spinners are semiskilled operators, almost exclusively women, who are responsible for many rows of spinning frames containing thousands of spindles (as many as 5,500 spindles in the more efficient mill). The spinner's job consists of manually loading the machines with roving bobbins, twisting the ends of roving yarn from the spent bobbin to full bobbin, repairing breaks, cleaning the machines, and patrolling the long lines of machines carefully watching for broken strands or nearly-exhausted bobbins. Another operator (the doffer), almost always male, removes the full bobbins from the spindle and replaces them with empty bobbins.

Spindle speeds have increased greatly over the last 15 years, advancing from 10,000 rpm in 1950 to 13,500 today, and 20,000 rpm are now feasible. Consequently, fewer new machines are required in new or modernized spinning rooms for a given level of output than with older equipment. Also, the use of instrumentation to improve quality and shorten downtime is increasing. In addition, automatic maintenance and cleaning auxiliary equipment is now basic to spinning room modernization. Overall, fewer, faster machines and auxiliary laborsaving equipment are reducing the number of operators required in the modern spinning room by as much as a third.

The most radical innovation in the spinning room is the automatic doffing machine which eliminates the task of manually removing full bobbins, one the most time-consuming operations in the mill. The doffer-operator simply starts the doffing machine and patrols the row of spindles to check for malfunctions. Commercially available only for the past two years, the automatic doffing machine reduces unit requirements for doffers by two-thirds. It may eliminate the job of doffer by transferring the duty of operating the doffer machine to the spinner. Although the doffing machine was initially feasible only in new mills with wide space between rows of spindles, smaller units are expected to be commercially available in 1968.

A revolutionary technique, still in the developmental stage, is open-end spinning which eliminates the ring, traveler and spindle. Some industry men believe that this innovation will lead to significantly greater mill automation, because conventional ring spinning is a relatively discontinuous operation. One model of an open-end machine is said to utilize high-pressure forced air to combine into one simplified process the three conventional functions of roving, spinning and winding, significantly reducing unit labor requirements.

Winding and warping. In the winding and warping operations, yarn is transferred from the relatively small spinning frame bobbins into larger packages for use on the loom or for other uses, such as knitting. Inspection of yarn to correct weak or torn parts is another important function of the process.

Workers involved in winding and warping account for about 10 percent of total employment in the mill. Women make up the majority of workers, and most jobs are relatively low skilled.

Winding, one of the most expensive processes in the textile mill, has become highly automatic. On some of the newest machines, the bobbins are creeled by means of highly mechanized bobbin-conveying systems, replacing manual creeling, and automatic knotting devices operate at every spindle. One of the most important laborsaving aspects of the newest winders is the automatic tying-in of the yarn ends on full bobbins. Such new machine models require only two operators in place of five on conventional machines.

Probably the most important development in winding is an automatic winding attachment to the loom which replaces quilling (filling winding) as a separate process, thereby eliminating many steps in conventional manufacture. This is another example of the combination or integration of processes. Savings in floor space provide room for more productive equipment, and unit man-hours on winding can be reduced by as much as 60 percent. Such loom-winding attachments are being widely adopted by mills which can use this innovation.

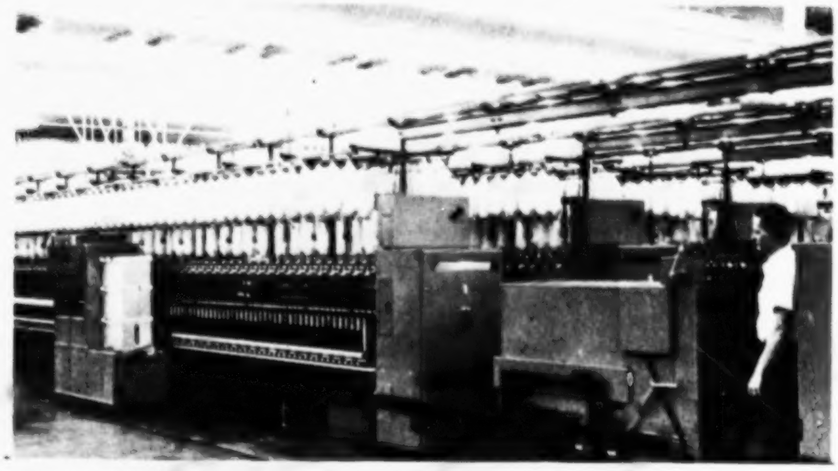
Weaving. Weaving consists of the interlacing of crosswise or filling threads with lengthwise or warp threads on a loom to form fabric, known as grey cloth. The weaving room, containing hundreds or thousands of looms, is the largest and the noisiest work area in the mill.

Almost half of all operatives in an integrated mill are employed in the weaving room. Weavers (half of them are women) are among the highest paid workers in the mill. One weaver may supervise as many as 200 looms in a new mill (depending on fabric construction), compared with one-fifth less in the typical mill. Loom fixers, almost exclusively men, do the maintenance and repair work and are usually the most skilled and highest paid workers in the mill.

Loom speeds have been increased by 25-50 percent in the past 15 years (depending on fabric construction). New looms operate at about twice the speed of most looms in the average mill. Manual lubrication is being replaced in some of the most technically advanced mills by centralized lubrication systems, which consist of a circuit of injectors that deliver the proper quantity of oil to several points on each machine at 30-minute intervals. This technique eliminates downtime required for machine maintenance.

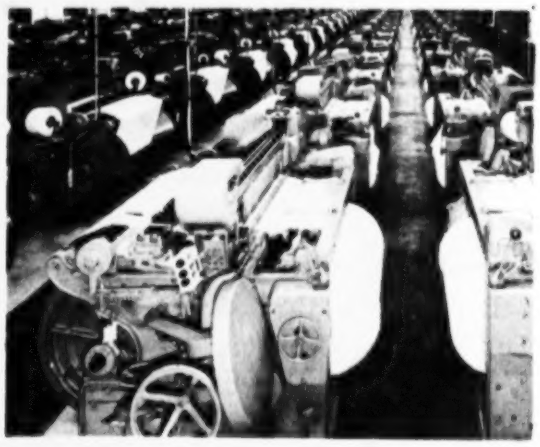
Advances in spinning, winding and weaving reduce unit labor costs.

The mechanical doffer moves along the spinning frame, removes full bobbins and places empty bobbins on the spindles. Manual doffing is one of the most costly operations in the mill.



In most mills, filling yarn (yarn woven crosswise into the fabric) is wound or quilled in a separate area. In this weaveroom, the yarn is wound directly on the loom, eliminating several costly handling operations.

Increased speed, reduced maintenance, less noise, fewer preparatory processes are some of the advantages of the shuttleless loom shown on the right.



A major innovation in weaving is the shuttleless loom which operates without shuttle, bobbin, or bobbin-feeding mechanism. Increased speed, reduced maintenance, a higher degree of automaticity, less noise, and fewer preparatory processes are some of the advantages of the shuttleless loom over the conventional loom. However, until very recently, shuttleless looms were capable of producing cloth with only one selvage edge (instead of two), and buyer resistence to this limited industry acceptance. Also the relatively high cost of this loom and advances in conventional looms have been deterrents to greater adoption. Although shuttleless looms account for only a small fraction of all looms, industry interest is widespread. Many mills have installed shuttleless looms, in addition to conventional looms, to evaluate their performance.

The water-jet loom, made in Japan and Czechoslovakia, is the newest innovation in weaving and several U.S. mills reportedly have pilot installations. These are said to have advantages over conventional looms, but at present can be used only to weave continuous-filament manmade fibers.

Finishing. Chemical and mechanical finishing techniques and cloth inspection complete the processes of textile cloth manufacture in a fully integrated mill. Many discrete operations such as singeing, desizing, bleaching, dyeing, printing, preshrinking, calendering, and others may be included in finishing. New finishing treatments aim at improving "wash and wear" properties of cloth and its resistance to creasing, staining, etc.

Manpower required in these operations are generally unskilled or semiskilled, except for the cloth grader and the technical personnel. Men hold most of the jobs in the finishing department, but women are usuallly employed as cloth inspectors.

Continuous finishing systems are replacing some of the older, discontinuous techniques, significantly reducing time and labor requirments and upgrading quality of output. For example, a new continuous open bleaching system, which is found in only a few mills, takes only 7 minutes compared with 9 hours required 10 years ago. Newly developed bleaching agents and auxiliary chemicals make possible this combination of processes. These systems usually include advanced instrumentation and central consoles.

Combinations of machinery for other than wet-processing are also reducing unit man-hours in a few modernized mills. For example, one machine sews the cloth together, scrapes, brushes, shears, and then rerolls it. This results in considerable laborsavings per unit.

One of the most important advances in finishing, the use of the computer for process control, is discussed below.

Instrumentation

At different stages of production, various types of auxiliary equipment for measurement and control are being introduced which reduce downtime and permit more efficient quality control.

Stop-motion devices that cut off the machine's operation to prevent yarn damage, and electronic devices that activate machine adjustments when required, are being increasingly installed on new equipment. For example, in the drawing process, yarn thickness is controlled by a photoelectric cell which detects differences in light passing through the yarn and adjusts the drawing frame automatically.

Mechanical and electronic recording instruments, which replace visual scanning and other slower methods of inspection and recording, are being adopted increasingly. An electronic monitoring system in the weaveroom, for example, provides a visual and printed record of the performance of every loom on a central console. However, these systems are being installed primarily in newer mills, and their application may be limited because of cost.

The use of radioisotopes in textile manufacture for measurement and control of plastic and rubber coatings is an interesting example of the application of electronic instrumentation for quality control. Radioisotopes give off radiation which pass through solid material, the intensity of the radiation varying with the thickness and density of the material. Measurements can be recorded continuously, and feedback controls permit automatic adjustment of the coating. The results are greater product uniformity, reduced downtime, and unit man-hour savings.

Instrumentation is most advanced in the wet finishing processes. In more modernized mills, almost every detail of pressure, speed, temperature, and flow of several machines is controlled from a central console which one man can monitor. Latest models of finishing equipment are more extensively instrumented, and output per man-hour is higher.

Computers are used by some large companies for data processing and are being extended to control finishing processes. According to a 1965 McGraw-Hill survey of large companies, 56 percent of the large textile companies responding reported computer installations. Major uses included accounting, inventory control, sales analyses and orders, and long-range production planning. Although the application of computer technology is still very limited, recent developments indicate potential growth. For example, several large textile firms opened central electronic data-processing offices in the last few years, coordinating information from 40 mills or more. Several hundred management specialists, computer technicians, and clerical workers will process, analyze, and store mill information, and then feed back appropriate reports to mill managers. Plans are being made for advanced computer equipment which may make possible daily mill control.

Computer applications for process control are only in the beginning stages. The first computer-directed control system was installed in a large finishing plant to control a complex dyeing procedure. It operates valves automatically, sequencing the filling, heating, cooling, pressurizing, emptying, and recording data on these procedures. This system is said to result in greater productivity and in a consistently high-quality product. It is expected, moreover, that computer control will be expanded to include other major finishing processes.

New Methods of Production

New methods of fiber and fabric manufacture are broadening textile markets. Nonwoven fabric (bonded web of fibers), needle-punched fabric, foam laminates, coated fabrics and texturized and stretch yarns are some of the new products now being fabri-

Cleaning and materials handling are greatly reduced in modernized mills.

In this mill, machines are cleaned automatically by overhead cleaners and underfloor return-air tunnels.

Here, the heavy beam of fabric is moved mechanically along overhead rails.

cated. Most of these, such as the so-called nonwoven fabric, require fewer man-hours per unit of output than conventional fabrics; others, such as stretch fabric, may require additional machinery and labor.

The nonwoven fabrics are neither spun, woven, nor knitted and basically involve a web-formation process in which modified textile or papermaking machinery is used. In 1965, about 128 million pounds of bonded fiber fabrics were produced, compared with negligible quantities in the late 1950's. Nonwoven materials are used for interlining, padding, and facing for apparel; they also are used for bagging and wrapping materials and other industrial uses.

Tufting, one of the most successful textile manufacturing innovations, has revolutionized carpet manufacture in a little over a decade. Tufted carpet production is now 10 to 20 times faster than loom-woven production, and in 1966, changes in the process were introduced, which it is claimed, could further increase speed and cut costs. In 1965, tufted carpets and rugs accounted for about 80 percent of all soft floor covering mill shipments. Before 1950, practically no tufted carpets were manufactured.

The needle-felting process, used in blanket manufacture, is replacing conventional spinning and weaving processes. It produces 40 or 50 yards of cloth per hour compared with 3-4 yards on conventional looms. This process is being utilized by at least one manufacturer, and consumer acceptance among other factors will determine its diffusion in the coming years.

One new type of cloth production which is gaining industry interest, is the Mali process developed in East Germany. New fabric-forming machines are said to stitch together fiber layers at 10 to 50 times the output of conventional looms with significant unit laborsavings. This process has only recently been made commercially available in the United States.

Chapter IV. Assessing the Rate of Technological Change

Several quantitative measurements are presented in this section covering different facets of the industry's technological progress. These include indicators of output per man-hour for selected sectors of the textile industry, for plants within one sector, and for model plants; capital per unit of output; and horsepower and electric energy per worker.

Indicators of Output Per Man-Hour

Relating output to man-hours (i.e. productivity) constitutes a useful although partial indicator of the pace of technological change. The ratio reflects the impact on production processes of changes in the quantity and quality of plant and equipment, in the layout and flow of materials, in the simplification and standardization of products, and in many other management measures for improving efficiency. It is also affected by changes in the skill, training, education, morale, and health of the entire work force. Furthermore the relationship may reflect economic shifts within industries, such as the shift of production from low productivity to high productivity plants.

Measurement of productivity in the textile industry is faced with the usual problems of determining the best measure of output for individual products, allowing for quality and product mix changes; calculating appropriate weights; and insuring reasonable comparability between input and output measures. These problems are all complicated by the fact that textile establishments vary significantly in the degree of integration of their production facilities. Since an establishment only reports the value of its final products or shipments, changes in integration may lead to misleading estimates of production changes.

Although definitive measurements of productivity for the industry are not yet available, substantial overall improvement from 1947 to 1965 is suggested by the rise in output-- indicators range from about 60 to 75 percent--and the sharp decline in man-hours of 24 percent. From 1960 to 1965, rough measures of textile output indicate an increase of 30-35 percent, while man-hours rose only 4 percent. The improvement in manpower utilization in the overall industry reflects several different factors over the years. Although expenditures for plant and equipment were very low in the 1950's, wide-scale closing of marginal mills with obsolete equipment tended to raise the level of technology and efficiency of the industry. In the 1960's, industry growth and high investment were the major factors. The changes for the textile industry as a whole reflect substantial variation among individual sectors of the industry. This variation can be illustrated by data for the broadwoven sectors. Comparable data on output and man-hours for each of the three fiber broadwoven sectors, reported by Census, suggest improvements in manpower utilization. Although increasing utilization of blends and mixtures makes distinctions by fiber less sharp, nevertheless, it is useful to examine trends in some of the individual fiber sectors.

The improvements result from different movements in output and man-hours. In cotton broadwoven, for example, output (in square yards) rose 5.8 percent from 1947 to 1965, while man-hours declined sharply, 33.8 percent. In woolen and worsted broadwovens, however, output declined to almost half (45.2 percent) over this period, but man-hours decreased considerably more (67.1 percent). On the other hand, more efficient manpower utilization in the synthetic fiber broadwoven sector resulted from more than a doubling in output (118 percent) coupled with only a negligible decline in man-hours (0.5 percent).

The hosiery index of productivity is an official BLS series and was constructed with appropriate weights and allowance for product mix changes. Employment in the hosiery industry accounted for about 10% of total employment in 1966. Output per man-hour for all employees in the hosiery industry rose at an average rate of 6.6 percent annually from 1957 to 1965, compared with a 2.9 percent annual increase from 1947 to 1957. From 1960 to 1965, the rate of increase was 6.8 percent.

The sharp increase in productivity after 1957 is associated with the relatively more rapid rise in output (see table 10) and a major change from full fashioned to seamless hosiery. In 1957, less than a third of all women's hosiery was seamless; in 1965, 95 percent was seamless.

Table 10. Hosiery Industry, Output per Man-Hour and Related Data, Selected Years

(1957-59 = 100)

Year	Output	All employee man-hours	Output per all employee man-hour
1947	87.3	129.7	67.3
1957	95.9	106.9	89.7
1960	104.3	96.5	108.1
1965	136.0	90.6	150.1
	Average annual percent change		
1947-57	0.9	-2.0	2.9
1957-65	4.5	-2.1	6.6
1960-65	5.5	-1.3	6.8
1947-65	2.5	-2.0	4.6

SOURCE: Bureau of Labor Statistics.

The outlook over the next few years is for a continued high rate of productivity increase in the hosiery industry, assuming demand remains strong. Major cost-saving techniques may become more important, such as the one-process finishing technique which combines scouring, dyeing, and finishing; automatic turning attachments, and toe closing machinery.

Interplant Differences in Efficiency

Levels of output per man-hour differ widely among textile mills within an industry sector because of differences in age of equipment, managerial and employee skill, type of organization, size of mill, and many other factors related to efficiency. Table 11 presents comparative data for 1958 on value added per production worker--an approximate measure of productivity--for the "more efficient," "less efficient," and average textile mill in ten industry sectors. Scattered data for 1963 suggest that the 1958 differentials have persisted.

Table 11. The Ratios of "More Efficient" to "Less Efficient" Plants[1] and to Average Plants, 1958

Industry sector	Value added per production worker man-hour		Capital expenditures per employee	
	"More efficient" to "less efficient" plants	"More efficient" to average plants	"More efficient" to "less efficient" plants	"More efficient" to average plants
Weaving mills, cotton	2.4	1.5	1.4	1.1
Weaving mills, synthetics	2.9	1.7	1.5	1.1
Weaving, finishing mills, wool	2.7	1.6	1.5	1.3
Narrow fabric mills	2.2	1.4	1.8	1.4
Hosiery mills	3.0	1.6	2.6	1.4
Knit outerwear mills	4.4	2.4	1.5	1.2
Knit fabric mills	3.4	1.8	2.1	1.2
Finishing plants, cotton	2.4	1.7	3.4	2.1
Tufted carpets and rugs	3.1	1.8	1.3	1.3
Yarn mills, excluding wool	2.5	1.6	1.1	1.3

[1] Plants in each industry sector were ranked by the ratio of payrolls to value added. The plants in the lowest quartile of this ranking were considered the "more efficient," those in the highest quartile, the "less efficient." Value added is used as the measure of output or the net contribution of the manufacturing process in the industry. No adjustments are made for product mix, degree of integration, or other variations among plants.

SOURCE: Department of Commerce, Business and Defense Services Administration.

The "more efficient" mills are defined as those in the first quartile of establishments ranked in ascending order of the ratio of payrolls to value added. According to this efficiency concept developed by the U.S. Commerce Department, the plant with the lowest ratio of payrolls to value added would be the most efficient mill. The measurements are approximate, and do not take differences in product mix into account, but they provide some indication of the variance in efficiency among textile mills.

The difference in average value added per production worker man-hour between the "more efficient" group of mills and the average group of mills ranged from about 40 percent in the narrow fabric industry to about 140 percent in the knit outerwear industry. In the cotton and synthetic weaving mills, value added per production worker man-hour in the "more efficient" mills was approximately 50 and 70 percent greater, respectively, than in the average mill. The differences between the "more efficient" and the "less efficient" group were considerably greater, as would be expected. Value added per production worker man-hour in the "more efficient" mills of the knit outerwear industry was four and a half times as large as in the "less efficient" mills. That was the greatest difference, but the smallest difference (in the narrow fabric industry) was still considerable; it was more than double.

One of the factors closely tied to efficiency is the volume of capital expenditures. As shown in table 11, capital expenditures per employee in 1958 were substantially larger in the "more efficient" mills than in the "less efficient" mills of most textile sectors. For example, the "more efficient" cotton finishing plants reported capital expenditures per employee that were three times as much as did the "less efficient" plants. Differentials in weaving mills (more labor intensive than finishing) were not as great.

Output Per Man-hour in Hypothetical Model Plants

The rate of technological change may also be assessed on the basis of the trend of output per man-hour in hypothetical plants designed by engineers with the best available technology of a given year. Comparisons of such model mills over time trace the progress made by engineers in developing technological improvements without reference to the extent of their actual application in industry. These studies provide a useful indicator of the potential for productivity increase.

Engineering studies of model cotton print cloth mills producing identical products are available for four periods over the past 56 years. Since cotton print cloth is an important broadwoven product (accounting for about a fourth of all broadwoven), for which mill operations are generally similar to those for other broadwovens, the figures provide a rough indicator of changes in the manpower utilization of this textile sector based on the newest textile technology. These data do not, however, represent other sectors of the industry or the industry as a whole.

A 1936 study by an engineering consultant for the Bureau of Labor Statistics presented estimates of unit labor requirements in 1910 and 1935 for cotton print cloth mills (producing cloth, 80x80, 39 inches wide, 80 threads and 4 yards per pound) "containing the most efficient equipment (in that year) which could be recommended by an engineer if he were designing a mill to be built." In 1956 and 1961, the Whitin Machine Works, a leading manufacturer of textile machinery, published similar "engineering" data for those years which were adjusted for comparability with the earlier study. Comparable data for 1966 were published by the American Textile Machinery Association.

According to these studies, output per man-hour in a model cotton print cloth mill of 1910 was 3.1 pounds; in 1935, 4.6 pounds. By 1956 it had risen to 10.5 pounds and by 1966 to 14.6 pounds an hour. (See table 12.) The average annual increase in output per man-hour was 1.6 percent from 1910 to 1935, 4.1 percent from 1935 to 1956, and 3.4 percent from 1956 to 1966.

Table 12. Output per Man-Hour in Model Cotton Print Cloth Mills

Year	Pounds per man-hour
1910	3.1
1935	4.6
1956	10.5
1966	14.6
	Average annual increase (percent)
1910-35	1.6
1935-56	4.1
1956-66	3.4

SOURCE: Bureau of Labor Statistics; Whitin Machine Works; American Textile Machinery Association.

The annual rate of technological progress, (using this engineering concept) was slightly greater in the 21-year span from 1935 to 1956 than in the 10-year period from 1956 to 1966. Technological change, however, varied greatly among different mill operations in each of the three periods. As shown in table 13, the sharpest average annual reductions in unit labor requirements in the 1956-61 period (no detailed data are available for 1966) occurred in the opening through spinning operations which represent 30 percent of the mill's man-hours. Spooling, warping and weaving departments also reduced unit man-hour requirements; other operations in the mill during this period showed no significant change. In the 1935-56 period, on the other hand, every mill department registered unit man-hour declines, and the largest occurred in the opening through roving operations. From 1910 to 1935, average annual unit man-hour reductions for the plant as a whole were relatively low, but in the spooling and warping operations, reductions were greater than in the other two periods.

Table 13. Changes in Unit Man-Hour Requirements, by Operation, in Model Cotton Print Cloth Mills, Selected Years

Operation	Man-hours as percent of total 1961	Average annual percent change		
		1910-35	1935-56	1956-61
Total	100.0	-1.7	-3.8	-3.4
Opening-roving	9.4	-2.6	-6.1	-7.2
Spinning	20.0	-1.3	-4.0	-7.8
Spooling and warping	6.5	-3.8	-2.9	-2.3
Slashing and drawing-in	2.9	-2.1	-4.3	0
Weaving	44.4	-1.4	-2.4	-1.7
Cloth room	9.1	-.6	-2.8	0
Miscellaneous	7.6	+.4	-4.7	0

NOTE: Because of rounding, sums of individual items may not equal totals.

SOURCE: Based on studies by the Bureau of Labor Statistics and Whitin Machine Works.

This study of model print cloth plants, using the best available technical methods, can be used in estimating roughly the potential rate of growth in output per man-hour over the next decade. Compared with the estimate of 14.6 pounds per man-hour for a model print cloth mill shown above, the actual level in 1966 in such mills is estimated by industry experts to average about 10 pounds per man-hour (the level of the model plant of 1956). The 46 percent gap between the average and the model plant of 1966 may be taken to represent the approximate potential growth in output per man-hour that might occur if all obsolete machinery were replaced by the most modern plant and equipment.

More realistically, should it take the average mill 10 years to attain the level of the model mill, the average annual rate of increase in the print cloth industry would be 4 percent from 1966 to 1976. Should the catching-up period be less than 10 years because of a continuation of today's high investment or extensive closing of older mills, the rate would exceed 4 percent a year.

Fixed Capital and Capital-Output Ratios

Declining capital requirements in the textile industry relative to capacity or output is another partial indicator of technological advance, reflecting improvement in machinery and more intensive utilization.

Estimates of the stock of fixed capital provide an approximate indicator of the aggregate amount of physical equipment in place. Data covering postwar trends in the textile industry, estimated by the National Industrial Conference Board, indicate that real fixed capital has been steadily decreasing, reflecting the retirement of obsolete equipment and the low rate of investment. In 1963, fixed capital (in constant prices) totalled $2.8 billion, a decline of 39 percent or an average decline of 3.3 percent annually from 1948. Textile mill capacity 1/ (in constant prices) increased 12.5 percent between 1948 and 1963. The ratio of fixed capital to capacity, therefore, declined sharply over this period--by more than 46 percent. (See table 14.) Or stated differently, the textile industry's capacity in 1963 was about 13 percent greater than in 1948 with only about 60 percent of the physical equipment of 1948.

Table 14. Stock of Fixed Capital and Capacity,
Textile Mill products, 1948 and 1963

Year	Fixed capital in 1954 prices ($ million)	Capacity[1] in 1954 prices ($ million)	Fixed capital-capacity ratios
1948	4,698	15,076	.312
1963	2,849	16,954	.168
	Percent change		
1948-63	-39.4	12.5	-46.2

[1] Estimated by applying the minimum capital-output ratio (in constant prices) achieved in a recent period, current or prior to the given year, to the stock of capital (in constant prices) of the given year.

SOURCE: Based on data from the National Industrial Conference Board.

Data for selected types of machinery tend to confirm the declining trend of fixed capital-capacity ratios, or increasing ratios of capacity per unit of capital. For example, the number of looms in mills producing cotton and manmade fiber broadwoven fabrics decreased 22 percent from 1948 to 1965. Production of these fabrics (in square yards), however, was about 25 percent greater in 1965 than in 1948. Therefore, as shown in table 15, output per loom increased 61 percent over this period.

The increase in productivity of real fixed capital or decrease in real fixed capital per unit of output since 1948 reflects, largely, improvements in the average quality of textile machinery and more intensive machine utilization. As idle obsolete machinery was scrapped and marginal plants closed, remaining machinery and subsequent modernized equipment operated at greater speeds, had greater capacity, and were generally more productive than the machinery replaced. At the same time, mills went on three shifts

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1/ The National Industrial Conference Board estimates capacity by applying the minimum capital-output ratio (in constant prices) achieved in a recent period, current or prior to the given year, to the stock of capital (in constant prices) of the given year.

a day. As shown in table 15, loom hours declined only 2 percent from 1948 to 1965, although looms declined 22 percent over those years. Cotton and manmade fiber broadwoven production per loom hour increased 27 percent in those 17 years.

Also, rising productivity of real fixed capital may reflect the general reduction in the number of production processes and the greater use of filament synthetics which require fewer processes. For all these reasons, considerably fewer machines are required for a given level of output than was necessary 10 to 15 years earlier, and less plant is required to house them.

Capital-output ratios will probably continue to decline through the 1960's, as new plant and equipment replaces less productive equipment, and as management learns to utilize new machinery more efficiently. Future trends in the capital-output ratio are indicated by data for model print cloth mills described earlier. The 1966 mill was designed to produce slightly greater output than the 1956 mill with one-third fewer looms and 15 percent fewer spindles. On a constant dollar basis, covering all machinery and equipment (excluding refrigeration), the cost for this 1966 model mill was about 11 percent less than for the 1956 mill.

Table 15. Cotton and Manmade Fiber Broadwoven Production, Looms and Loom Hours, 1948 and 1965

Item	Unit	1948	1965	Percent change
Broadwoven production ----------	(Million square yards)	13,371	16,688	24.8
Looms in place[1] ----------------	(Thousands)	500	389	-22.2
Loom hours[1] ------------------	(Millions)	2,613	2,549	-2.4
Production per loom in place -----	(Thousand square yards)	26.7	42.9	60.7
Production per loom hour --------	(Square yards)	5.1	6.5	27.4

[1] Looms in place and loom hours in cotton and manmade fiber broadwoven mills, December 31. The data for cotton and manmade fiber looms and loom hours in woolen and worsted broadwoven mills are not disclosed by the Bureau of the Census, but are negligible.

SOURCE: Based on data from the Bureau of the Census.

Growth in Electric Energy Consumption

The trend in the amount of electric energy consumed per unit of capital or per worker represents another measure of technological advance. In spite of a large decline in capital stock, electric energy used rose almost 80 percent from 1947 to 1965. Consumption of electric energy per production worker increased two and one-half times from 1947 to 1965, at the average annual rate of 5.3 percent.

Slightly larger increases in consumption per production worker occurred in the early postwar period, 1947 to 1958, as employment declined sharply, and less electrified, obsolete plants closed. In recent years, the increase in electric energy consumption per production worker resulted from the installation of larger, faster machinery, electric equipment, electronic controls, and new lighting and air conditioning equipment.

Although considerable variation exists among different sectors, electrification of the textile industry, as a whole, remains relatively low. Electric energy consumption per production worker in textiles in 1965 was about two-thirds of the average for all manufacturing, a less favorable ratio than in 1947. Paper and allied products in 1965 consumed about four times as much electric energy per production worker as did textiles, a more favorable ratio than in 1947. The apparel industry, however, is considerably less electrified (as shown in table 16), although the increase since 1947 in electric energy per production worker in apparel was greater than in textiles.

Table 16. Electric Energy Consumed, Textile Mill Products and Selected Industries, 1947 and 1965

(Kilowatt hours per production worker)

Industry	1947	1965	Percent change
Manufacturing	11,827	35,019	196
Textile mill products	8,760	22,295	154
Apparel and related products	874	2,617	199
Paper and allied products	39,279	89,441	128

SOURCE: Bureau of the Census.

Another indicator of changing textile technology is the shift in power generation from the older method of on-site production to the purchase of energy from central generating systems. As mills are modernized and older plants are shutdown, the relative importance of self-generated electricity is reduced. Hence, less than 5 percent of electric power used by textile mills in 1965 was generated by the mill, compared with 7 percent in 1958 and 18 percent in 1947.

Electric energy consumed per production worker will probably continue at or above the growth rate of the last few years, as modernization continues at a rapid pace. Installation of air conditioning will be a major factor in the growth of electric power use. A 1961 Textile World survey of 89 of the largest textile mills revealed that only 11 percent of these mills had completely air conditioned their manufacturing areas and 44 percent only parts of the manufacturing areas.

Horsepower of Power Equipment

Horsepower of power equipment per production worker also indicates the level of mechanization because it is a measure of the mechanical power available in the industry. This ratio for the textile industry almost doubled from 1939 to 1962, the latest data available. The annual rate of growth from 1954 to 1962 was 3.7 percent, more than 50 percent above the 1939-54 rate.

Relative to all manufacturing, however, the textile industry remains considerably less mechanized. Horsepower per production worker in textiles in 1962 was about 50 percent of the ratio for all manufacturing, almost unchanged from the 1939 or 1954 relative level. (See table 17.) The outlook in the next decade is for increased horsepower of power equipment as the industry continues to modernize.

Table 17. Horsepower of Power Equipment per Production Worker, Manufacturing and Textile Mill Products, 1939, 1954, and 1962

Year	Manufacturing	Textile mill products	Textiles as percent of manufacturing
1939	6.5	3.4	51.7
1954	9.6	4.8	50.2
1962	12.5	6.4	51.5

SOURCE: Bureau of the Census.

Chapter V. Production Trends and Prospects

To assess the impact of technological change on manpower, it is essential to review and project the trend in the industry's output. This chapter covers postwar production trends, changes in the composition of output, and the outlook for textile demand.

Trends in Production

Textile production has not kept pace with all manufacturing output in the postwar period. Various measures of textile output indicate that it rose an average of about 2.7-3.2 percent annually from 1947 to 1966, compared with the significantly higher rate of 4.7 percent for all manufacturing.

The recent textile growth rate has been much higher than in the earlier postwar 1947-57 period, reflecting increased demand for both civilian and defense purposes. According to the published Federal Reserve Board (FRB) index 1/, textile output increased only 1.3 percent a year from 1947 to 1957, compared with 4.3 percent per year for total manufacturing. (See table 18.) Between 1957 and 1961, the average rate of increase of textile output doubled to 2.6 percent annually. The recent period, 1961-66, was one of sharp recovery

Table 18. Indexes of Production for Manufacturing and Textile Mill Products, Selected Years

Industry sector	Indexes of production (1957-59 = 100)				Average annual percent change			
	1947	[illegible]	1961	1966	1947-57	1957-61	1961-66	1947-66
Total manufacturing	66.4	100.8	109.6	158.7	4.3	2.1	7.7	4.7
Durable	64.3	104.0	107.0	165.1	4.9	.7	9.1	5.1
Nondurable	67.2	96.7	112.9	150.7	3.7	4.0	5.9	4.3
Textile mill products[1]	85.0	96.5	107.1	142.3	1.3	2.6	5.9	2.7
Yarns and fabrics	88.1	97.5	104.7	141.2	1.0	1.8	6.2	2.5
Cotton and man-made fabrics	79.2	96.9	105.8	148.8	2.0	2.2	7.1	3.4
Cotton yarns and fabrics	86.0	97.6	104.9	125.5	1.3	1.8	3.7	2.0
Man-made fabrics	58.8	98.0	108.9	220.2	5.2	2.7	15.1	7.2
Wool textiles	145.7	100.9	98.1	97.4	-2.6	-.7	-.1	-2.1
Wool fabrics	145.8	101.5	97.7	93.7	-2.6	-1.0	-.8	-2.3
Knit goods	75.0	93.6	116.9	156.0	2.2	5.7	5.9	3.9
Hosiery	94.8	97.4	111.5	152.0	.3	3.4	6.4	2.5
Knit garments	61.4	91.0	120.6	158.9	4.0	7.3	5.7	5.1

[1] Includes floor covering mill products, although not presented separately. Does not include "Miscellaneous" textile mill products included in SIC 22.

SOURCE: Federal Reserve Board.

1/ The FRB index of production is frequently used as a measure of the output of the textile industry and its components, but the data have certain limitations. The indexes for recent years are being revised for consistency with benchmarks based on 1958 and 1963 Census of Manufactures. Preliminary unpublished estimates, for the textile industry as a whole, show indexes of output of 3 and 7 percent, respectively, above the currently published unadjusted figures.

with an average annual growth rate of 5.9 percent, but this was still considerably below the 7.7 percent rate for manufacturing. Although the textile growth rate lagged substantially behind the rate for durable goods manufacturing, it was similar to the rate for nondurables in this later period.

Substantial variation exists in the growth rates of individual industries in the textile mill products industry group. The fastest growing sector was the manmade fabric industry in which output increased at an average annual rate of 5.2 percent between 1947 and 1957, only 2.7 percent annually between 1957 and 1961, and then rose to an average rate of 15 percent a year between 1961 and 1966. In contrast, cotton yarns and fabrics, the largest sector of the industry, grew more slowly: 1.3 percent annually between 1947 and 1957, 1.8 percent annuallly between 1957 and 1961, and 3.7 percent annually from 1961 to 1966.

The knit goods sector has undergone substantial and sustained growth, resulting from fashion changes favoring knit garments, and substantial military demand. Output of knit garments, one of the major subdivisions, rose 4.0 percent annually from 1947 to 1957, 7.3 percent from 1957 to 1961, and 5.7 percent in the 1961-66 period. The hosiery sector of knit goods was virtually at a standstill from 1947 to 1957, but maintained output growth at an average of 3.4 percent annually from 1957 to 1961, and 6.4 percent in the 5 years from 1961 to 1966.

Wool textile production has been in decline throughout the postwar period but in recent years has been stabilizing. Between 1947 and 1957, output declined at the average rate of 2.6 percent a year. Between 1957 and 1961, the industry decline slowed down to less than 1 percent annually. From 1961 to 1966, there was almost no change in output due partly to greater demand for defense purposes.

Floor covering mill products, not listed separately in table 18, has been one of the fastest growing sectors of the textile industry. According to Census data, the quantity of shipments of woven, tufted and knitted floor covering products in 1966 was more than two and a half times greater than in 1958, an average annual growth rate of almost 13 percent. Tufted carpets and rugs, which accounted for about 90 percent of the total, increased at the average annual rate of more than 17 percent in those eight years.

Long range estimates for the textile industry as a whole, by industry experts, indicate a high rate of growth in the 1970's, above the rate for the 1947-66 period, but below the rate of 1961-66. A greater proportion of teenagers and members of new family formation age groups--the major textile consumers--and increasing income are expected to sustain high consumer demand. Textile products may also compete more successfully in industrial markets as new products are developed. On the other hand, reduced defense expenditures and increasing imports may dampen the growth rate.

Changing Composition of Fiber Consumption

Changes in the volume and composition of mill fiber consumption are indicators of the changing markets and technology of the industry. In 1966, a total of 9.0 billion pounds of fiber were consumed in mills, 45 percent more than in 1957 (or an average 4.2 percent annual gain). From 1947 to 1957, fiber mill consumption had declined slightly.

Today's textile industry is a multifiber industry, with machinery that facilitates production shifts from one fiber to another. Almost without exception, new mills are being built today equipped with versatile machinery that could process cotton, practically all known types of synthetics, and synthetic-cotton blends without changing the machinery layout. Blends and mixtures have been taking an increasing share of production accounting for almost a fifth of all broadwoven yardage in 1965. Many factors including fashion, technology, and price changes determine the relative use of the various fibers.

Cotton's dominant position was seriously weakened after World War II by the advent of noncellulosics. From 1947 to 1957, cotton mill consumption declined 13.0 percent (1.4 percent annually), compared with a two-thirds increase (5.4 percent annually) in total manmades. Although cotton consumption increased after 1957, by 1966 it was approximately at the 1947 level. Only in 1964, 1965 and 1966 did cotton use increase significantly, due to lower cotton prices competitive with world market prices ("one-price" cotton 1/), and greater military demand. As pointed out earlier, the import penetration ratio of cotton (imports of semi manufactured and manufactured products as a percent of domestic consumption, measured in pounds of fiber) rose almost steadily since the mid 1950's, except in 1962-64, and reached 10 percent in 1966. In 1966, cotton accounted for 42 percent of total fiber consumed in the mill (cotton equivalent basis), 2/ considerably below the 1957 level of 58 percent. (See table 19.)

To meet the competition of manmade fibers, natural fiber processors have undertaken research programs and promotion campaigns, but on a relatively small scale. The National Cotton Council estimates that in 1965 the cost of research for cotton, by private and government agencies, totaled $26.5 million compared with $135 million for manmade fibers. Promotional expenditures were also a small fraction of the amount reported by their competitors.

The outlook is for a further decline in cotton's share of the fiber market. On a cotton equivalent basis, cotton may only constitute a third of all fiber consumed by 1975, compared with 42 percent in 1966.

The successful development and marketing of a variety of manmade fibers is one of the most significant trends of the postwar period. In 1947, rayon and nylon were the only

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1/ Under the government's new program dating from April 1964, prices of raw cotton sold domestically and for export were equalized. "One-price" cotton legislation has been extended to August 1970.

2/ Comparison of fiber consumption is more meaningful in terms of cotton equivalent units rather than in terms of actual poundage consumed because the number of yards of cloth produced from a pound of manmade fiber is greater than the amount produced from a pound of cotton or wool fiber. Therefore, differences in processing losses and differences in fabric weights ("covering power") should be taken into account to determine the quantity of material realized. The Textile Economics Bureau and the Department of Agriculture have developed these data on fiber consumption on a comparable cotton equivalent basis. As shown in table 19, manmades, in cotton equivalents, accounted for 57 percent of total fiber consumption in 1966, compared with 44 percent measured in actual pounds consumed.

Table 19. Percent Distribution of Mill Fiber Consumption, Actual Pounds and Cotton Equivalents,[1] 1947, 1957, and 1966

Type of fiber	Actual pounds			Cotton equivalent basis[1]		
	1947	1957	1966	1947	1957	1966
Total[2]	100.0	100.0	100.0	100.0	100.0	100.0
Manmade fiber	16.5	28.8	44.4	23.1	39.2	56.6
Rayon and acetate	15.7	19.3	18.0	21.8	24.2	19.6
Noncellulosic	.7	7.9	22.9	1.2	12.7	32.2
Glass	.1	1.6	3.5	.1	2.3	4.8
Cotton	72.6	65.2	51.5	71.0	57.9	41.6
Wool	10.9	5.9	4.1	5.8	2.9	1.8

[1] Converted by the Department of Agriculture to enable interfiber comparison on the basis of the quantity of material realized. Adjustment was made for differences in the waste involved in manufacturing fabric from various fibers and differences in the average weight of generally compariable end products produced from the different fibers.

[2] Does not include silk.

NOTE: Because of rounding, sums of individual items may not equal 100.0.

SOURCE: Based on data from the Department of Agriculture.

manmade fibers. Today, about 20 generic forms of manmade fibers are produced. These include three forms of cellulosics (rayon, acetate, and triacetate); four forms of fibers from nonfibrous materials such as glass; and more than ten synthetic noncellulosic fibers, including nylon, polyester, acrylic, spandex, olefin, and others.

The increase in manmade fiber consumption accounted for more than four-fifths of total fiber growth over the 9 year period from 1957 to 1966. Manmade fiber use rose to a high of 4.0 billion pounds in 1966, about two and a quarter times that of 1957 or at an average rate of 9.3 percent annually. In 1957, manmade fibers accounted for 39 percent of total fiber consumption on a cotton equivalent basis; by 1966, the ratio had risen to 57 percent.

More than four-fifths of the increase in manmade consumption from 1957 to 1966 was made up of noncellulosics, including nylon, polyester, acrylic, spandex, olefin, and others. Noncellulosics consumed in mills rose at an average annual rate of 19 percent from 1957 to 1966. The growth rate was particularly high in the 1960's; 22 percent annually from 1961 to 1966. Consequently, these fibers increased their share of total manmade consumption from 32 percent in 1957 to 57 percent in 1966 (cotton equivalent basis).

Cellulosics (rayon and acetate), in contrast, have not held their share of the manmade market. Although cellulosic fiber consumption increased at the annual rate of 3.4 percent from 1957 to 1966, its relative share of total manmade fiber declined from 62 percent to 35 percent over those 9 years. Rayon's dominant position in tires, one of its major markets, was reversed for the first time in 1963, culminating nylon's continuous inroads over the past 10 years. On the other hand, increased use of rayon in home furnishings and clothing has more than compensated for the industrial market loss.

Outlook for Manmade Fiber Consumption

Total manmade fiber consumption will continue to increase significantly in the next decade, despite growing research, new product development, and promotional activities by natural fiber processors. By 1975, manmade fiber consumption may account for 65 percent--on a cotton equivalent basis--of all fibers consumed, compared with 57 percent in 1966.

Of the manmade fibers, noncellulosics will continue to be the major growth fiber group in the next 5 to 10 years. It is not generally expected, however, that it will increase at the high annual rate of the 1960's, i.e., at the average of 22 percent per year from 1961 to 1966. Industry experts estimate a rate closer to 10 percent annually over the 10 year period.

Rayon's competitive position will depend largely on its ability to maintain its share of the tire cord market, one of its major outlets. Despite the inroads of nylon, almost all original equipment tires are made of rayon cord because of its lower price and because nylon tires tend to become slightly flat after standing. Car manufacturers' requirements for higher tenacity cords, however, are expected to reduce rayon demand, particularly as nylon properties are improved and other cord materials are developed. The recent growth of polyester tire cord also threatens rayon's supremacy in the original tire market. Although research continues to improve rayon tensile and elongation properties, many industry men believe that rayon's share of the market will be seriously reduced in the next decade. Radial tire production which requires more cord strength and rigidity, may, in part, be responsible for this cutback.

Intensive research programs and consumer promotion activities stimulate demand for manmade fibers. Many fiber companies assist mills in adapting their equipment to use of manmade fibers. They maintain finishing laboratories for dyeing research, and send technical service groups to mills to help make up new fabric constructions. More than 4,000 manmade fiber items are now on the market, and research on modifications of physical and chemical properties is being pursued to create new products.

Besides the attractiveness of easy care and long life to consumers, several advantages to the manufacturers account for the increased use of manmade fibers. Major advantages in processing of many manmade fibers are lower unit labor requirements, relatively stable prices, shorter processing time, and greater potential for integrated processing. Filament yarn, for example, which accounts for more than half of all manmade yarn produced, is shipped to textile mills directly from chemical plants, ready for preparatory weaving operations. All the conventional operations of an integrated mill usually required to produce yarn from fiber, i.e., opening, blending, picking, carding, roving and spinning are eliminated.

Many manmade fibers almost entirely eliminate waste, a serious time and labor consuming problem in the use of natural fiber. The average processing loss (with no allowance for salable waste) has been estimated at 13 percent for cotton, 5 percent for wool, 4 percent for manmade staple, and 1.5 percent for manmade filament. In some cotton yarn mills, cleaning lint and fly may constitute as much as 20 percent of total labor costs.

Moreover, a new technology in the apparel industry, durable press, is accelerating the shift from all cotton to polyester blends. All-cotton fabric do not, at this time, have the abrasion resistance required for durable press, a process which imparts a permanent wrinkle-free appearance. According to one estimate, about 80 percent of all dress shirts, traditionally made of all-cotton fabrics, will be made of polyester-cotton blends next year. Durable press is also being adopted for various household textiles, such as sheets.

In addition, the price differential between polyester and cotton has been narrowing, strengthening the fiber shift. Polyester capacity expansion has been accompanied by sharp price declines in the last decade. Although cotton prices also declined in this period, the ratio of polyester to cotton prices fell from almost four in 1955 to less than three in 1966. Cotton prices, moreover, are expected to rise since the more desirable qualities of cotton are in short supply and cotton stocks generally are signficantly reduced.

Wool consumption declined fairly steadily after World War II. Although some leveling-off took place in the early 1960's, 1964 consumption hit a new low, and the 1966 consumption of 370 million pounds was at the 1957 level. As pointed out earlier, the import penetration ratio (measured in fiber poundage) of wool increased sharply to almost 30 percent in the mid-60's. As a percent of total fiber used in mills (converted to cotton equivalents), wool accounted for only 1.8 percent of the total in 1966 compared with 2.9 percent in 1957 and 5.8 percent in 1947. The outlook is for a continued decline in wool's share of the total fiber market.

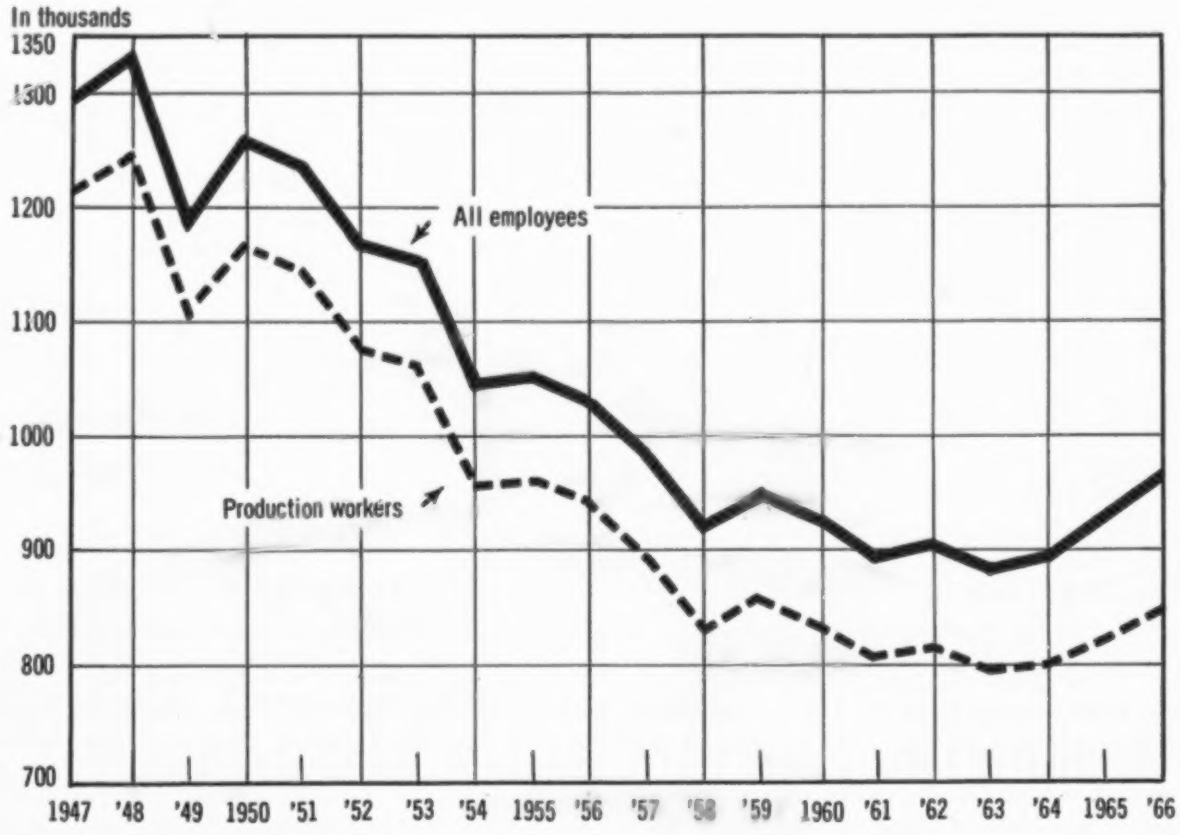
This chapter reviews past trends and future prospects of the industry's employment profile, including overall employment, regional distribution, unemployment, age of workers and the employment of women and Negroes. Occupational trends and projections are presented in chapter VII.

Employment Trends

Following its postwar peak of 1,332 thousand in 1948, textile employment began the sharpest long term decline in its history. The trend was almost continually downward, with the sharpest reductions in 1949, 1954, and 1958. (See chart 4.) Slowly leveling off in the 1960's, employment hit the postwar low of 885 thousand in 1963. From 1948 to 1963, employment had fallen 33.5 percent, or an average of 2.7 percent annually. (See table 20.)

As pointed out earlier, multiple factors were responsible for this decline. Shrinking domestic and foreign markets seriously reduced demand and many hundreds of mills closed their doors. At the same time, mill modernization, more efficient managment and the shift to synthetic fiber reduced unit labor requirements.

Chart 4. Employment in Textile Mill Products Industry[1] 1947-66



1/ See appendix table 3 for data.

Source: Bureau of Labor Statistics.

Table 20. All Employees and Production Workers, Textile Mill Products, Selected Years

Year	All employees	Production workers
	In thousands	
1947	1,299.0	1,220.0
1948 (Peak)	1,332.0	1,248.0
1963 (Low)	885.4	793.4
1966	961.5	857.1
	Average annual percent change	
1948-63	-2.7	-3.0
1963-66	2.8	2.6
1947-66	-1.6	-1.9

SOURCE: Bureau of Labor Statistics.

Although textile output had risen sharply after 1959, employment did not advance. Additional man-hours required were provided to a great extent by lengthening the workweek, rather than by hiring new workers. However, as output continued its sharp rise between 1963 and 1966, both employment and man-hours rose significantly. Employment moved upward from 885.4 thousand to 961.5 thousand, at an average annual rate of 2.8 percent--the first increase since 1948 of more than 1-year's duration. The improved employment situation since 1965 was due largely to greater defense expenditures for textile products.

Overall, approximately 962 thousand employees were working in the textile industry in 1966, about 338 thousand fewer than in 1947, a decline of 26 percent or an average annual decline of 1.6 percent. Employment in all-manufacturing increased 23 percent in this period.

Employment Outlook

The outlook is for a continuation of the long-term decline, but at a slower rate. Projections of textile employment to 1975 range around 880 thousand, or about 5 percent below the 1965 employment level. This represents an average annual decline of about 0.5 percent over the decade, compared with the average rate of decline of 1.9 percent per year between 1947 and 1965.

This projection was prepared by the Bureau of Labor Statistics for the National Commission on Technology, Automation and Economic Progress and is discussed in detail in Appendix Volume I to the Commission's report. A basic assumption underlying the projection is that the national unemployment rate in 1975 will be 3 percent. Moreover, the projection assumes that the trend in textile imports and exports in the next decade will continue at about the same average rate as in the 1947-65 period.

These projections must be considered as conditional statements, not firm predictions about the future. While the assumptions used are reasonable in the light of past experience, they and the projections based upon them are subject to revision in the light of new developments. As in other economic projections, inadequate data and imperfect understanding of the complex relationships among determinants of output and employment could result in fairly wide margins of error.

Trend in Industry Sectors

Not only did employment in the textile industry decline in the post-World War II period, but the structure of employment by industry sector changed significantly.

The broadwoven sectors (cotton, synthetic, and wool), the largest homogeneous group, declined sharply between 1947 and 1966--over 40 percent (an average of 2.8 percent annually) compared with a decline of 26 percent (1.6 percent annually) for all textile employment. This employment loss accounted for about four-fifths of the total postwar decline in textiles. Although employment increased in the cotton and synthetic broadwoven groups from 1963 to 1966, only synthetics rose above the 1959 level. Wool weaving and finishing continued its downward trend during this period. (See table 21.) In 1947, broadwovens represented about 50 percent of all textile employment; by 1966 employment had fallen to 380 thousand, or to less than 40 percent of the total.

Knitting, the second largest industry group comprising 234 thousand employees in 1966, declined only 3 percent from 1947. Employment declined sharply in the 1947-57 decade but recovered in recent years. From 1963 to 1966, it rose an average of 3.2 percent annually. By 1966, knitting accounted for almost a fourth (24.4 percent) of total textile employment, compared with less than a fifth (18.7 percent) in 1947. Data for knitting sectors (hosiery, knit outerwear and underwear) are available only for the years since 1959. As shown in table 21, employment in knit outerwear rose most rapidly from 1963 to 1966 (5.4 percent annually), and rose 2.9 percent annually from 1959 to 1966. Employment in miscellaneous hosiery and socks declined substantially (3.4 percent annually) from 1959. In the other sectors of knitting, employment in 1966 was at about the 1959 level.

Employment in the third largest industry sector, yarn and thread, was 116 thousand in 1966, a decline of 2.2 percent annually since 1947. Sharp increases in recent years (4.6 percent annually from 1963 to 1966), brought employment up about 7 percent above 1959. Relative to total textile employment, yarn and thread employment remained fairly stable: about 13 percent in 1947 and 12 percent in 1966.

Production Worker Employment

Production worker employment declined more sharply (average annual rate of 1.9 percent) than total employment (1.6 percent annually) in the post-war period 1947-66. (See table 20.) In almost all sectors of the industry, production workers showed a greater decrease or a smaller increase than all employees.

Although the ratio of production workers to total textile employment has been declining, it is still high relative to all manufacturing. In 1966, production workers ac-

Table 21. All Employees and Production Workers in Textile Mill Products Industry, 1959, 1963, and 1966

Industry sector	All employees				
	1959	1963	1966	Average annual change	
				1959-66	1963-66
	(In thousands)			(Percent)	
Manufacturing	16,675	16,995	19,186	2.0	4.1
Textile mill products	945.7	885.4	961.5	.2	2.8
Cotton broadwoven fabrics	259.4	228.2	237.2	-1.3	1.3
Silk and synthetic broadwoven fabrics	81.0	85.9	97.0	2.6	4.1
Weaving and finishing broadwoolens	60.4	49.6	45.4	-4.0	-2.9
Narrow fabrics and smallwares	28.5	27.5	31.4	1.4	4.5
Knitting	219.8	213.3	234.4	.9	3.2
Women's full and knee length hosiery	53.7	51.4	54.2	.1	1.8
Miscellaneous hosiery and socks	53.9	44.3	42.3	-3.4	-1.6
Knit outerwear	59.5	62.2	72.9	2.9	5.4
Knit underwear	33.2	31.7	34.7	.6	3.1
Finishing textiles, except wool and knit	77.3	75.2	79.6	.6	1.9
Floor covering	37.6	37.6	43.5	2.1	5.0
Yarn and thread	108.3	101.2	115.9	1.0	4.6
Miscellaneous textile goods	73.5	66.9	77.2	.7	4.9
	Production workers				
Manufacturing	12,603	12,555	14,273	1.8	4.4
Textile mill products	857.4	793.4	857.1	-.1	2.6
Cotton broadwoven fabrics	243.5	211.3	218.0	-1.6	1.0
Silk and synthetic broadwoven fabrics	74.2	77.5	87.5	2.4	4.1
Weaving and finishing broadwoolens	53.9	43.7	39.6	-4.3	-3.2
Narrow fabrics and small wares	24.9	24.1	27.9	1.6	5.0
Knitting	199.7	192.0	209.8	.7	3.0
Women's full and knee length hosiery	49.3	47.1	49.6	.1	1.7
Miscellaneous hosiery and socks	50.1	40.8	38.7	-3.7	-1.8
Knit outerwear	53.3	54.7	63.7	2.6	5.2
Knit underwear	29.8	28.6	31.2	.7	2.9
Finishing textiles, except wool and knit	67.0	64.2	67.3	.1	1.6
Floor covering	31.9	31.2	35.6	1.6	4.5
Yarn and thread	100.3	93.1	107.7	1.0	5.0
Miscellaneous textile goods	62.0	56.2	63.8	.4	4.3

SOURCE: Bureau of Labor Statistics.

counted for 89.1 percent of all textile employment compared with 93.9 percent in 1947. In manufacturing, the ratio was 74.4 percent in 1966. (See table 22.)

Trends in Unemployment

The decline of textile employment was accompanied by a relatively high rate of unemployment among textile workers throughout the postwar period. The rate of textile unemployment exceeded that of manufacturing in every year from 1958 (the first year for which data are available) through 1966, except in 1961 and 1962. Unemployed textile workers constituted 9.5 percent of the textile labor force (i.e., those employed in the textile industry, and those unemployed whose last job was in the textile industry) in 1958 but declined to 3.7 percent by 1966. As shown in table 23, only in 1965 and 1966 was the rate below 5 percent.

Table 22. Production Workers as Percent of Total Employment

Year	Manufacturing	Textile mill products
1947	83.6	93.9
1957	76.8	91.0
1966	74.4	89.1

SOURCE: Bureau of Labor Statistics.

Table 23. Unemployment Rates in Manufacturing and Textile Mill Products,[1] 1958-66

Year	Unemployed as percent of civilian labor force in category	
	Manufacturing	Textile mill products
1958	9.2	9.5
1959	6.0	7.2
1960	6.2	6.3
1961	7.7	6.8
1962	5.8	5.2
1963	5.7	6.7
1964	4.9	5.7
1965	4.0	4.3
1966	3.2	3.7

[1] The denominator of the unemployment rate includes the employed, classified according to their current job, and the unemployed, classified according to their last civilian job, if any; the numerator includes the unemployed workers classified according to their last job.

SOURCE: Bureau of Labor Statistics.

Moreover, the unemployment rate may be understated because it is based on the last job held, not on the industry in which duration of employment was longest. For example, workers who spent all their working lives in the textile industry and who may have taken other types of employment after being unemployed for some time, would not be counted as unemployed textile workers. Also, the extent of the unemployment problem is not fully reflected in the unemployment rate because of the exit from the labor force of laid-off workers who retire, or return to home or school.

Some textile areas, particularly in New England, continue to have substantial and persistent unemployment, despite economic expansion nationally. In Fall River, Mass. area, formerly a major textile center, the unemployment rate, according to the Bureau of Employment Security, was 6.2 percent in 1966, having dropped from over 10 percent in 1963 and 1964. The Altoona, Pennsylvania area in the Appalachian region had an unemployment rate of 6.6 percent in 1966. The lack of alternative job opportunities is a major problem. On the other hand, some textile centers such as Utica, New York have increased employment opportunities as a result of diversification programs which brought in new industries.

Although large scale layoffs were most severe during the sharp decline of the 1950's, they continued to occur in the 1960's. A study of layoffs of 100 or more workers based on reports to the Department of Labor, covering the period July 1963 through June 1965 (a period of brisk activity in the textile industry and in the economy generally), showed a total of 33 textile establishments and 9.6 thousand workers affected by permanent layoffs during this period. Most of these were in New England and the Middle Atlantic States. These two areas accounted for 85 percent of the textile mills and 64 percent of the employees affected.

Of the 33 textile mills affected, 13 listed competitive pressures, 9 reported relocation and 2 gave consolidations and mergers as the primary reason. These reasons accounted for 74 percent of the employees laid off. (Primary reason for the other mills were given as "other".) None of the mills reported that technological change was the primary reason for layoff. It may be presumed, however, that competition from more technically advanced plants was an important factor underlying the other reasons given for layoffs.

Laid-off textile workers as a group face special difficulties in finding reemployment. Almost 60 percent of all textile employees are in mills located in non-metropolitan areas which usually have few alternative opportunities within the area. Moreover, textile skills are not easily transferred to other industries. Women, who comprise almost half the textile work force, usually have family ties which limit their mobility in the search for work. An additional problem is the textile workers' relatively high average age.

Some of the expected decline in employment through 1975 may take place through the retirement of older workers, and the transfer of people to other industries. But the workforce will remain vulnerable to high unemployment rates as marginal plants with obsolete equipment shutdown during periods of slackening demand.

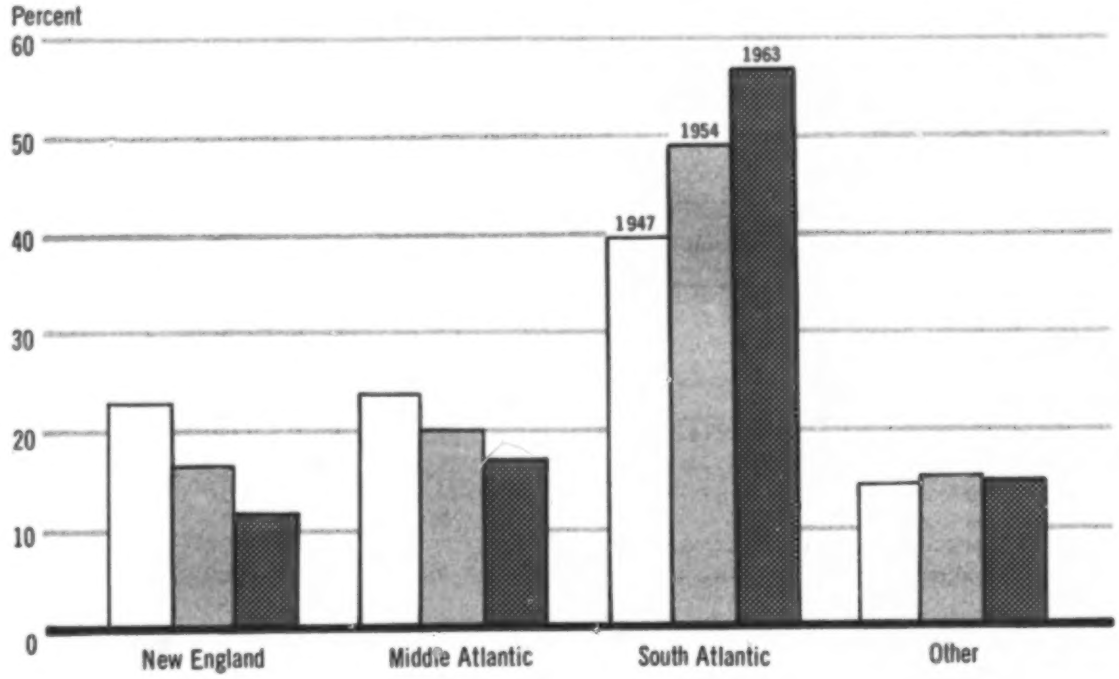
Regional Distribution of Jobs

Greater concentration of jobs in the South continues the long term regional pattern. Continuing liquidation of older, high-cost, marginal plants in New England and in the Middle Atlantic States, rather than any marked expansion in southern employment accounted for the distributional shift. Employment in the South Atlantic States increased only about 2 percent from 1958 to 1963, but employment in New England and Middle Atlantic States declined sharply (18 and 13 percent respectively) over this period. New England's share of textile jobs contracted from 23 percent in 1947 to 14 percent in 1958 and to 12 percent in 1963. By 1963, 57 percent of all textile workers were employed in South Atlantic States, as shown in chart 5.

In leading textile states, the industry's relative importance as a source of employment has been declining. In North Carolina, for example, textile mill products is still the major industry, but in 1963 it provided only 41 percent of all manufacturing jobs in the state compared with 55 percent in 1947. In Massachusetts, the leading New England textile state, jobs in textile mills constituted 18 percent of all manufacturing jobs in 1947, and 6 percent in 1963.

Although the movement of cotton manufacturing mills to the South started at the turn of the century and gained momentum after World War I, the woolen and worsted industry did

Chart 5. Regional Distribution of Textile Employment [1]
1947, 1954 and 1963
(Percent of total)



[1] See appendix table 4 for data.
Source: Bureau of the Census.

not gain importance in the South until after World War II. An improved spinning system, developed in the South for woolen manufacture, was a major contribution to wool manufacturing technology and resulted in important cost savings. Unlike the movement in earlier periods, plants in the South are being fully equipped with the newest machinery, without the transfer of large amounts of equipment from northern mills. In addition, the establishment of southern wool processing plants enables mills to buy processed wool locally, whereas previously southern mills had to buy processed wool from the North.

In cotton manufacture, many of the historic causes for the shift southward continue to exist. These include lower power costs, lower wages and supplementary benefits, and various tax advantages. In addition, location closer to Southern synthetic mills is a new factor because of the use of multiple fibers by cotton cloth manufacturers.

The outlook is for an increase in the proportion of textile jobs in the South Atlantic States.

Changing Age Composition

As employment in the textile industry declined, the average age of the workforce rose fairly rapidly. The average (median) age of employed textile workers increased from 32.4 in 1940 to 40.7 in 1960, a considerably sharper rise than in all manufacturing. This was due in some measure to the movement of young adults to higher paying, expanding industries.

The proportion of older male employees, 45 and over, rose to about 40 percent of all male employees in 1960 compared with 26 percent in 1940. The proportion of females of 45 and over almost tripled: from 14 percent in 1940 to 37 percent in 1960. (See table 24.)

Table 24. Employed Persons, by Sex and Age Group, Textile Mill Products
1940, 1950, and 1960

(Percent of total)

Sex and age group	1940	1950	1960
Male:			
Total	100.0	100.0	100.0
Under 25	21.9	16.0	14.6
25-34	31.9	25.1	21.4
35-44	20.7	25.0	23.8
45-54	15.0	17.6	23.5
55-64	7.9	12.0	13.7
65 and over	2.7	4.2	2.8
Female:			
Total	100.0	100.0	100.0
Under 25	29.6	19.1	13.2
25-34	36.2	27.4	21.4
35-44	20.7	28.1	28.2
45-54	10.0	16.8	24.8
55-64	3.0	7.2	10.8
65 and over	.6	1.3	1.6

NOTE: Because of rounding, sums may not add to 100.0.

SOURCE: Bureau of the Census.

The outlook is for a further rise in the median age level over the next decade, as expanding, higher paying industries continue to attract younger textile workers. At the same time, many workers will reach retirement age, but whether they will be retained on their jobs will depend on the demand for textile labor.

Employment Outlook for Women

The textile industry has been a source of abundant job opportunities for women since its inception. More than 426 thousand women were employed in textile mills in 1966, and they constituted about 44 percent of all employees. This was considerably higher than the ratio for all manufacturing--27 percent. Although the percent of women to total employees has been slowly increasing since 1940, their relative position has diminished substantially over the long term. In 1870, women constituted about 60 percent of cotton mill workers compared with about 40 percent today.

The relative importance of women in employment varies widely depending largely on the nature of the work. Finishing, primarily a chemical process involving relatively hazardous working conditions, employs relatively few women--24 percent in 1966. In knitting, which requires considerable dexterity, women constitute about 68 percent of the work force. (See table 25.)

Significant increases in female textile employment usually occur at times of male labor shortages. For example, from 1940 to 1945, the increase in female labor in South Carolina textile mills accounted for over 90 percent of the State's total increase in textile employment. Since women can take the place of men in almost all textile operations, either directly or by breaking down the jobs into several operations, expansion of the female labor force requires little or no adjustment by the mill.

Job opportunities for women are also affected by technological change. Weaving, for example, was originally considered a man's occupation requiring physical strength. When power looms were introduced, however, women were considered capable of filling the job. As mechanization continues, more employment opportunities may be open to women in occupations previously considered too dangerous or too difficult physically for them. In the carding room, for example, where the proportion of women is relatively small, mechanization of lap removal and suction cleaning may increase card tending jobs for women. On the other hand, some of the new developments in winding, drawing and packaging may reduce unit labor demand for women. For example, as industry adopts automatic attachments for winding on the loom, battery hands and winders, which are primarily women's occupations, will be reduced. In new and remodeled mills which have made this change, women's jobs related to these operations have been practically eliminated.

Women's relative position has been strengthened by the fact that, in recent years, men's jobs have been more affected by technological change than women's jobs. For

Table 25. Women Employees in Textile Mill Products Industry, 1959 and 1966

Industry sector	Number (in thousands)		As percent of all employees	
	1959	1966	1959	1966
Manufacturing	4,359.0	5,206.0	26.1	27.1
Textile mill products	414.5	426.8	43.8	44.4
Cotton broadwoven fabrics	101.4	91.8	39.1	38.7
Silk and synthetic broadwoven fabrics	28.5	34.0	35.2	35.1
Weaving and finishing broadwoolens	20.7	16.1	34.3	35.5
Narrow fabrics and smallwares	15.3	17.8	53.7	56.7
Knitting	152.3	160.4	69.3	68.4
Women's full and knee length hosiery	35.8	41.2	66.7	76.0
Miscellaneous hosiery and socks	38.7	30.6	71.8	72.3
Knit outerwear	44.1	53.0	74.1	72.7
Knit underwear	24.6	24.2	74.1	69.7
Finishing textiles, except wool and knit	16.4	19.3	21.2	24.2
Floor covering	11.8	13.7	31.4	31.5
Yarn and thread	47.6	52.3	44.0	45.1
Miscellaneous textile goods	20.5	21.5	27.9	27.8

SOURCE: Bureau of Labor Statistics.

example, advances in materials handling and cleaning affect primarily men's jobs and have reduced labor requirements for men in these unskilled tasks. The proportion of women in the industry is thereby favorably affected.

Employment of Negroes

Negroes have made some employment gains in the textile industry. A total of about 44,000 Negroes were employed in the textile industry in 1960, compared with 25,000, 20 years earlier. (See table 26.) Negro employment advanced from 2.1 percent of total textile employment in 1940 to 4.6 percent in 1960. This ratio, however, was still lower than that for all manufacturing in 1960 (6.6 percent).

The bulk of the advance occurred between 1940 and 1950 when war and postwar production was at its highest level. Negro textile employment increased 73 percent in those 10 years. Between 1950 and 1960, the number of Negro workers in textiles increased 2.7 percent, as total textile employment fell by almost a quarter.

The South accounted for slightly more than half of the Negro increase from 1940 to 1950. Between 1950 and 1960, however, Negro employment declined in the South, and the ratio of Negro employment to total employment remained about the same, compared with the ratios in other regions which showed substantial increase. (See table 27.)

Annual data for South Carolina, one of the leading textile states, show a substantial increase in the Negroes' share of textile employment but only since the mid-1960's. The proportion of Negroes in textile mills was less than 5 percent for more than 30 years, except for 1945-49 when the ratio ranged from 5.1 to 5.5 percent. In 1965, the ratio was slightly over 6 percent, still below the 1925 ratio (see table 28), but in 1966, the ratio jumped to 10 percent. These data cover nonsalaried employees only.

Although a combination of long-term social and economic factors underlies the low ratio of Negroes in southern textile mills, there is evidence that some of these conditions are changing.

Table 26. Negro Employment in Textile Mill Products Industry, 1940, 1950, and 1960

Color and sex	Employment (in thousands)			Percent change	
	1940	1950	1960	1940-50	1950-60
Total employees[1]	1,170.0	1241.4	954.0	6.1	-23.1
Negro	24.8	42.9	44.0	73.1	2.7
Negro as percent of total	2.1	3.5	4.6	-	-
Male employees[1]	692.4	712.8	535.9	3.0	-24.8
Negro males	21.3	33.4	33.7	56.8	.9
Negro as percent of total males	3.1	4.7	6.3	-	-
Female employees[1]	477.7	528.6	418.1	10.7	-20.9
Negro females	3.5	9.5	10.4	173.1	9.3
Negro as percent of total females	.7	1.8	2.5	-	-

[1] Totals include nonwhites other than Negroes.

[2] Percentages based on unrounded data.

SOURCE: Bureau of the Census.

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Table 27. Textile Mill Employment by Region, Color and Sex, 1950 and 1960

(In thousands)

Region	1950			1960			Percent change 1950-60	
	Total	Negro		Total	Negro		White	Negro
		Number	Percent of total		Number	Percent of total		
Total:								
Northeast	554.0	8.3	1.5	303.5	11.0	3.6	-46.4	31.7
North Central	55.8	2.9	5.3	38.9	3.1	7.9	-32.2	4.2
South	617.1	31.0	5.0	598.0	29.3	4.9	-3.0	-5.8
West	14.6	.6	3.8	13.6	.8	5.6	6.3	36.2
Male:								
Northeast	328.4	5.3	1.6	171.2	5.8	3.4	-48.9	10.9
North Central	27.8	1.7	6.1	19.6	1.6	8.3	-31.2	-3.5
South	349.9	26.0	7.4	338.4	25.8	7.6	-3.5	-1.1
West	6.7	.4	5.7	6.7	.4	6.6	-.4	15.4
Female:								
Northeast	225.5	3.1	1.4	132.3	5.1	3.9	-42.9	67.3
North Central	28.0	1.2	4.4	19.3	1.4	7.4	-33.2	14.6
South	267.2	5.0	1.9	259.6	3.5	1.3	-2.3	-30.2
West	7.9	.2	2.2	6.9	.3	4.6	13.8	81.7

SOURCE: Bureau of the Census.

Table 28. Total and Negro Employment in Textile Mills[1] in South Carolina, Selected Years

(Employment in thousands)

Year	Total employment	Negro employment	
		Number	Percent
1925	70.1	4.6	6.6
1930	67.0	3.9	5.8
1935	83.6	3.8	4.6
1940	92.7	3.7	4.0
1945	109.5	5.6	5.1
1950	124.6	6.0	4.8
1955	127.2	5.9	4.7
1960	122.9	5.7	4.7
1965	133.3	8.2	6.2
1966	138.2	13.8	10.0

[1] Nonsalaried.

SOURCE: Department of Labor of South Carolina.

First, the social milieu which influences the attitude of textile workers toward Negroes is undergoing change. The closely knit society of textile mill towns, the rural background of the population and their isolation from urban centers have been factors that tended to restrict Negro employment, except at the lowest levels. Greater communication and mobility may be changing these community-work relationships. Opportunities for Negroes may also be expanded by the efforts of the Equal Employment Opportunities Commission.

Second, the traditional sources of labor supply for the textile industry in the South are diminishing as new, higher-paying industries are expanding, and attracting white labor. As long as wages have been higher in textiles than in many other local industries, textile mills usually have been assured of an adequate supply of white male workers. When white male workers were in short supply, white women were hired because women generally can perform almost all operations in the mill. For example, when white male workers were not available in South Carolina textile mills during World War II, white women were hired comprising about 90 percent of the increase in total employment from 1940 to 1945. Negro employment increased less than 2 thousand in this period, compared with an increase of almost 16 thousand white women. (See table 29.)

In the tight job market of the 1960's, however, the textile industry has had to compete with higher-paying industries not only for white male workers but also for white women who are finding employment in other industries. Of the net increase in women employment in South Carolina industries between 1940 and 1945, almost 80 percent went into textile mills; in the 1960-65 period, only 25 percent went into textile mills. The gap in traditional sources of labor accounted, in large part, for the gain in Negro employment from 1960 to 1965, as shown in table 29. In 1966, as white women workers declined in South Carolina textile mills, Negro employment rose from about 6 percent to 10 percent of total nonsalaried textile employment.

These favorable factors in the outlook for Negro employment may be offset by more widespread mechanization which tends to reduce the demand for unskilled workers. It has been estimated that about a third of all Negro workers in the textile industry of North Carolina and South Carolina in 1966 were unskilled laborers compared with about 10 percent of all white workers.

Table 29. Employment Changes in Textile Industry of South Carolina, by Sex and Color, 1940-65[1]

(In thousands)

Period	Total	Male white	Female white	Negroes
1940-45	16.8	-0.8	15.7	1.8
1945-50	15.0	15.2	-.6	.5
1950-55	2.6	1.9	.9	-.1
1955-60	-4.3	.6	-4.8	-.2
1960-65	10.4	3.6	4.4	2.5

[1] Not fully comparable; nonsalaried employment.

SOURCE: Department of Labor of South Carolina.

Chapter VII. Occupational Changes and Prospects

This chapter deals with occupational changes in the textile industry expected over the next decade resulting primarily from technological developments. Two approaches are adopted: first, potential changes in the content of key jobs are presented; second, industry-wide occupational changes are projected.

Job Content and Training

Changes in job content and skill requirements differ among the three major occupational categories: machine tenders, technical workers and supervisory personnel. Each, therefore, will be discussed separately. Major emphasis will be on the effect of latest machine technologies on the worker. Although the discussion is confined to the cotton textile industry, workers in the cotton, synthetic, and woolen and worsted industry have substantially identical duties and operate similar types of machines.

Machine tenders or operatives. Although cotton is processed through several different machines, the work performed and the skills involved are quite similar at many operations. The content of machine tender or operative jobs can be summarized in terms of seven basic work duties:

1. Creeling is the operation of loading the machine with the supply stock and removing the empty package-container. On carding machines, for example, it involves positioning the laps; on spinning frames, placement of full bobbins of roving; on looms, hanging beams and positioning bobbins of filling.

2. Doffing is the removal of full packages of processed material and replacing them with empty package cores. This involves removal of laps on pickers; full cans of sliver from cards or drawing frames; full bobbins of yarn from spinning frames; and cloth rolls from looms. This may be done by the machine operator, as in the picker operation or by an auxiliary worker, a doffer, as in spinning.

3. Repairing or piecing-up involves the operation of tying together broken fiber, yarn orthread, or attaching ends of new packages for processing. Drawing frame tenders pick up broken ends of sliver and mat and roll them together between thumb and fingers; spinners locate the ends of broken strands, thread them through guides, twist two ends together, and replace the bobbin.

4. Operating manual controls involves stopping and starting machines, and regulating machine speeds or other variables. On the warper and slasher, tenders regulate machine speeds. In finishing, operatives control valves regulating dye or solution.

5. Cleaning machines to remove accumulation of lint, dirt, sizing, and oil may be done in whole or part by machine operators, or by specialized cleaners, such as roll pickers, in spinning.

6. Materials handling duties comprise moving materials and stock from one operation to another. This may be done by machine operators or by workers whose major duty is materials handling, or by both.

7. Patrolling involves walking around many rows of machines and watching their operation closely. In spinning, tenders walk past several thousand spindles to detect broken strands and to note when bobbins are running out.

Generally, an operative's job is a combination of two or more of these duties. The card tender, for example, does all the following: creels or positions the roll of lap, doffs or removes the full cans, cleans machines, and patrols for malfunctions. The drawing frame tender's major duties include repairing fiber breaks, controlling machine speeds, creeling, doffing, cleaning, and patrolling. Some workers, however, perform only one major job, such as the spinning frame doffer who primarily doffs the full bobbins.

Future job content. Advancing technology is altering the content of machine operatives' jobs by changing the mix of their duties--i.e., the relative time allotted to each duty. In addition, machine trends in many new mills indicate that one or more of the operative's traditional duties are being entirely eliminated by transfer to the machine. These changes increase the time allotted for patrolling a greater number of machines.

Comparison of the approximate distribution of a spinner's time in a modernized mill of the 1950's and 1960's, and projected distribution for the 1970's as estimated by experts in the industry, reveals the following shifts:

Duties	1950's	1960's	1970's
	(Percent of time)		
Total	100	100	100
Repairs broken yarn, etc.	50	49	48
Creels or loads	10	12	0
Cleans	23	10	5
Patrols	14	27	45
Miscellaneous	4	2	2
Number of spindles patrolled	2,350	3,200	5,500

The spinner's cleaning, creeling, and repairing time will be reduced from more than 4/5 of his total time in the 1950's to about half in the 1970's, despite the fact that the number of machines tended will more than double. Consequently, the time available for patrolling will more than triple.

When the increase in spindle assignments is taken into account, the effect of advancing technology on traditional duties is evident. The spinner's time allotted to repair, per spindle, will decrease 60 percent from the 1950's to the 1970's. Part of the reduction in cleaning and creeling time may result from the use of unskilled auxiliary labor, such as roll pickers and creelers, which permits the spinner to tend more machines.

Similarly, the newest winding equipment also illustrates the shift in duties. The operative's duties on a nonautomatic winder or spooler involve placing the bobbins or cones of yarn on the machine, threading the yarn through the guides, piecing up the broken ends by twisting them together, and removing full winding bobbins. The operative on the newest automatic machines has none of these duties; the machine performs these tasks automatically. The operative's duties consist primarily of patrolling a much larger number of machines to detect malfunctioning.

Effect on the worker. It is difficult to generalize about the effect on the worker of increased mechanization. The gradual transferral of traditional skills to the machine alters the physical and psychological demands on the worker, but its impact varies depending on the degree of machine automaticity. Moreover, the relative effect of varying degrees of boredom or stress, for example, is difficult to ascertain.

Less physical labor. Mechanization of materials handling, and one-story plants with straight line layouts reduce the physically arduous jobs of pulling, pushing and hauling. In modernized mills, for example, operatives no longer handle 60 pound laps manually or push heavy cans of sliver. Physical labor involved in cleaning has also been greatly reduced.

Increased patrolling of machines, however, may require greater physical stamina, particularly for women workers. Many operatives must walk considerably longer distances to tend a larger number of machines than were required 10 years ago. For some operations, this may result in an increase in physical labor; in other jobs, in a replacement of equally difficult physical jobs of handling or cleaning.

Less manual dexterity. Dexterity will continue to be required on many machines for piecing-up or repairing broken sliver or yarn, threading yarn through guides, and other operative duties. Such skill is particularly important for specialized operatives such as tying-in hands who attach warp threads from full loom beams to the threads of nearly-exhausted beams. As shown earlier, however, the trend is toward a reduction in the time allotted for many repetitive, manipulative jobs, and even their elimination, as automatic machines assume knotting jobs, etc.

Greater responsibility. As capital investment per employee increases, downtime is more costly and the operative has a greater responsibility to monitor the machines closely. In 1966, investment per job in a model print cloth cotton mill was estimated at over $40,000, about 40 percent more than 10 years earlier. More highly integrated machinery of the newest mills requires a greater sense of responsibility because an error or oversight can result in the shut-down of an entire line of machines. Even in older modernized mills, the increase in the number of machines the operative now patrols may intensify time pressure and anxiety. Some automatic devices, on the other hand, may lessen certain time stresses, but may require the worker to be more alert to malfunctions.

Improved physical environment. Poor lighting, excessive noise, and poorly controlled heat and humidity which result in strain on the workers are being greatly reduced. New and modernized mills are installing fluorescent lighting, air conditioning, air cleaning systems, and when possible, reducing noise and vibration.

More formal training. Industry training or retraining generally involves the traditional method of learning on the job by assisting an experienced employee. However, some mills now apply a more scientific and formal approach to training which is believed to be more efficient. In these mills, a separate area is set aside where trainees are taught on actual machines or 'dummies' to perform their jobs before being assigned to the production floor. Trainees may be assigned to an instructor--loom fixer instructor or head weaver instructor--whose sole job is to develop qualified operatives. Work manuals, classroom lessons and progress reports may be part of the formal procedure.

Machine manufacturers are also involved in training programs, particularly in the installation of radically new equipment. In mills where shuttleless looms are installed, for example, loom fixers and supervisors may spend 4 weeks at the manufacturer's training center.

The bulk of operative jobs, however, do not require a longer period of training than was required with less mechanized equipment. Some highly automatic machines may require less training. Only a few skilled production workers, such as loom fixers, require additional technical training to diagnose and repair more complex and varied machinery.

In the opinion of some managers, educational requirements for textile jobs may be raised slightly over the next decade, to obtain a more responsible workforce with greater potential for adaptability to new machinery. The median school years completed by textile workers in 1960 was 9 compared with 11 in all-manufacturing, due in part to the relatively small proportion of professional and technical workers. Operatives in the textile industry had an average educational attainment of 8.5 years compared with 9.4 in manufacturing.

Technical Workers. Duties of technical personnel consist of planning maintenance programs, diagnosing machine failures, determining correct action, and supervising repairs by skilled repairmen.

More technical knowledge and greater experience will be required for the wider range of machines and more rapid acceptance of machine innovations. Technicians must have the ability to diagnose not only the mechanical and electrical problems but pneumatic, hydraulic, and electronic as well. As in the case of the operative, greater responsibility rests with the technical worker because of the high cost of downtime, particularly in mills with highly integrated machinery. Good judgment and the ability to make decisions rapidly are, therefore, of great importance.

Formal training programs for technical personnel on machine principles are often made available by machine manufacturers, usually with the installation of new machinery. Textile colleges provide courses in mathematics and engineering designed primarily for technical personnel in cooperation with the industry.

Supervisory and Management Staff. Traditionally, the overseer or foreman rose through the ranks and had little formal or technical education. Judgement and decision-making were primarily based on experience and a thorough knowledge of the mill. Today, in the most modern mills, production planning and decision-making are more precise and exacting and must be, at least in part, based on judgement derived from data analysis. For example, the weaveroom foreman in some new plants must make use of an electronic monitoring system which records the performance of every loom, visually and in printed reports. Analysis of these data enables him to plan or change production schedules and machine and crew assignments rapidly and efficiently.

The functions of mill managers and supervisors may be modified in the future by computerization in central offices. So far, computer applications are generally limited to market analysis and long-range planning, but some large textile firms plan to install input and processing equipment which will permit daily production analysis by the central office and possibly greater centralization of control. Opportunities for systems analysts and computer programers will be opened up in central offices of large textile companies.

Modern managers will probably need more formal education to effectively operate these mills. Many textile companies now regularly recruit college graduates, particularly from textile colleges, to assume management positions. This trend is expected to continue as textile companies move away from family-ownership toward more professionally oriented management in a corporate structure.

Industry Occupation Projections

Projections of the textile industry's occupational structure for 1975, based on data from the decennial Census of Population, were made by the BLS Division of Occupational Employment Statistics. Although changes in the industry's occupational structure reflect primarily technological developments, they are also affected by shifts in the relative importance of subindustries, changes in management organization, and the growth of larger corporations. Moreover, these projections reflect labor requirements and may not be consistent with actual occupational distribution in 1975 due to labor market conditions. For example, when operatives are in short supply (e. g. spinners), rationalization of jobs may permit transferring some of their duties to laborers, thereby increasing that occupational group.

The projected structure does not differ radically from 1960 and continues trends of the past 25 years. The bulk of 1975 employment will remain in the semiskilled operative group in spite of some decline from 1960. (See table 30.) A larger proportion of employees will be required in white collar occupations, and fewer in the blue collar group. Skilled worker requirements, however, will increase relative to the total.

Table 30. Percent Distribution of Textile Employment by Occupational Group, 1960 and 1975

Occupational group	1960[1]	1975
Total	100.0	100.0
White collar	14.0	17.9
Professional, technical, and kindred	1.5	2.5
Managers, officials, and proprietors	3.5	4.2
Clerical and sales	9.0	11.2
Blue collar	85.9	82.1
Craftsmen, foremen, and kindred	11.4	13.1
Operatives and kindred	67.5	63.3
Laborers	4.9	3.7
Service workers	2.1	2.0

[1] Based on Census data.

NOTE: Because of rounding, sums of individual items may not equal total.

SOURCE: Bureau of Labor Statistics.

Professional, technical and kindred workers, including engineers, technicians, chemist, and accountants are the fastest growing occupational group. Employment increased from 1950 to 1960, despite a decline in total textile employment. This upward trend is expected to accelerate over the next decade. By 1975, professional, technical and kindred workers may constitute 2.5 percent of total textile employment, compared to 1.5 percent in 1960.

Many new occupations are being created in this group. An air conditioning system in a large mill, for example, may require 7 to 8 technical employees for maintenance and operation. The larger mills now employ instrument technicians so that immediate servicing can be available. More quality control, waste control, and instrument engineers and technicians will be required.

Demand requirements will also increase for R&D scientists and engineers. According to the National Science Foundation, this (still relatively small) professional group increased more than 60 percent from 1958 to 1966 in the textile and apparel industry.

Managers, officials and proprietors declined from 1950 to 1960 due largely to the decline in the number of establishments but increased as a proportion of total employment. Assuming greater industry stability and the growth of corporate organizations, a moderate rise in numbers is projected. The proportion of managers, officials, and proprietors by 1975 is expected to increase to 4.2 percent of total employment, compared with 3.5 percent in 1960.

Clerical, sales and kindred workers declined slightly from 1950 to 1960 partly reflecting the reduction in the number of textile establishments. However, this group increased as a proportion of total industry employment. In the next decade, sales and associated personnel will play a more prominent role in the industry. The group is expected to rise to 11.2 percent in 1975 compared with 9.0 percent in 1960.

Craftsmen, foremen and kindred workers declined by about 10 percent between 1950 and 1960, but also increased in relative importance. Foremen, loom fixers, mechanics and repairmen are the three major occupations in this group. Employment in this occupational group is expected to increase over the next decade, reflecting the increasing importance of some of these occupations. By 1975, craftsmen, foremen and kindred workers may constitute 13.1 percent of total textile employment, compared with 11.4 percent in 1960.

Operatives and kindred workers, the largest textile occupational group, will continue to be adversely affected by technological advance. From 1950 to 1960, this occupational group declined more than a fourth, and its proportion to total employment was reduced. Weavers and spinners in yarn, thread and fabric mills, and stitchers, knitters, loopers and toppers in knitting mills are the major occupations in this group. BLS projections show a continuing decline of operatives as a proportion of textile employment. By 1975, this group will constitute about 63 percent of the total, compared with 68 percent in 1960.

Laborers declined sharply from 1950 to 1960, both in number and proportionately, because of greater mechanization and the shut-down of older mills. This trend is expected to continue as more mills mechanize materials handling and cleaning operations. Some modernized mills have reported reductions of 25 percent in unskilled jobs. In some new mills, not a single person is employed to haul material. It is estimated that by 1975, laborers will constitute 3.7 percent of textile employment, compared with 4.9 percent in 1960.

Service workers, which include janitors, guards, etc., are also expected to continue to decline slightly, both in number and as a proportion of total employment. In 1960, service workers constituted 2.1 percent of the total; by 1975, they may be down to 2.0 percent.

Chapter VIII. Working Conditions and Adjustments to Technological Change

Technological changes have a pervasive effect on labor-management relations and working conditions. This chapter deals with labor-management relations, working conditions and earnings, and employee adjustments to technological change.

Working Conditions

Working conditions in the textile industry are largely a matter of management discretion, particularly in southern mills. Only about 27 percent of all textile workers were in mills covered by bargaining agreements in 1965, compared to over 60 percent in all manufacturing industries. The major unions are the Textile Workers Union of America, the United Textile Workers of America, and the International Ladies' Garment Workers' Union (knitting establishments), all affiliated with the AFL-CIO. The Amalgamated Lace Operatives of America is an independent union.

Contraction of the Northern textile industry, where union organization is strongest, seriously depleted union ranks. Attempts to organize Southern mills have been relatively unsuccessful. Nearly seven-eighths of New England cotton workers, but only one-eighth of those in the Southeast were employed in mills having collective bargaining agreements in September 1965. Although relatively few Southern cotton mills were covered by union agreements, the number of workers involved was substantially greater than in the North. Five times as many workers were covered in the Southeast as in New England. In synthetic textile mills, coverage was lower--about three-fifths in New England, two-fifths in Middle Atlantic States, and only 1 percent in the Southeast. In actual numbers, less than a thousand synthetic mill workers were employed in covered mills in the Southeast, compared to 9-10 times as many in each of the other areas.

Efforts to secure wage rate increases and greater fringe benefits are major issues in collective bargaining. With few exceptions, negotiations are on a single-employer basis. In some sectors of the industry, particularly in New England and Middle Atlantic states, settlements with a leading mill or employer-association set the pattern for other mills. Pattern setting, however, was more prevalent in the 1940's. In the final analysis, wage patterns in Northern mills are greatly influenced by leading non-union southern mills. Southern union mills attempt to achieve the wage rates and benefits obtained in Northern contracts, but the non-union pattern usually predominates.

Average weekly hours for textile production workers reached a postwar high of 41.9 in 1966 reflecting near-peak capacity utilization. (See table 31.) Except for 1964 and 1965, this was more than an hour longer than any year since 1947. Overtime increased to 4.4 hours in 1966, compared with 2.2 in 1957. Compared with the workweek in manufacturing, the textile workweek was longer in every year since 1961, in contrast to the 1947-60 pattern.

Three shifts have become fairly common in the postwar period. Nearly all broadwoven mills have provisions for three shift operations in most production departments. Third shift operations accounted for about a fourth of the workers in the Southeast and a fifth or a sixth in the other regions in 1965. Except for northern wool mills, second shift operators usually do not receive differential pay, but third shift operators received 7 cents an hour above day rates in New England and 5 cents in the South in 1965 in cotton, synthetic and wool mills.

Table 31. Hours and Earnings of Production Workers in Manufacturing and Textile Mill Products, 1947 and 1957-66

(Annual averages)

Year	Average weekly hours		Average hourly earnings		Average weekly earnings	
	Manufacturing	Textile mill products	Manufacturing	Textile mill products	Manufacturing	Textile mill products
1947	40.4	39.6	$1.22	$1.04	$49.17	$40.99
1957	39.8	38.9	2.05	1.49	81.59	57.96
1958	39.2	38.6	2.11	1.49	82.71	57.51
1959	40.3	40.4	2.19	1.56	88.26	63.02
1960	39.7	39.5	2.26	1.61	89.72	63.60
1961	39.8	39.9	2.32	1.63	92.34	65.04
1962	40.4	40.6	2.39	1.68	96.56	68.21
1963	40.5	40.6	2.46	1.71	99.63	69.43
1964	40.7	41.0	2.53	1.79	102.97	73.79
1965	41.2	41.8	2.61	1.87	107.53	78.17
1966	41.4	41.9	2.71	1.96	112.19	82.12

SOURCE: Bureau of Labor Statistics.

Earnings and Compensation

Two-thirds of cotton broadwoven production workers and three-fourths of the synthetic fabric workers in 1965 were paid on the basis of time rates, i.e., a set amount earned each hour which is not related to production. Usually this provides a single rate for a given occupation. The remaining third of the cotton workers and a fourth of the synthetic workers were paid on the incentive or individual piece rate system.

Average hourly earnings in textiles are still among the lowest in manufacturing. In 1966, textile earnings were $1.96 compared with $2.71 for all manufacturing. (Table 31.) Textile hourly earnings were up 88 percent over 1947; overall manufacturing earnings more than doubled. Since 1957, however, the percent increase in textile earnings was almost as high as that for all manufacturing. Regional wage differentials still exist, but they are narrowing for most occupations. Table 32 shows the change over an eleven year period in wage rates for selected key jobs.

Table 32. Hourly Earnings of Workers on Cotton Carded Yarn or Fabric, Selected Occupations, New England and Southeast Regions, 1954 and 1965

Occupation	1954		1965	
	New England	Southeast	New England	Southeast
Men:				
Doffer	$1.36	$1.24	$1.89	$1.87
Loom fixer[1]	1.68	1.52	2.28	2.26
Weaver, plain loom	1.46	1.33	1.98	1.97
Women:				
Spinner, ring frame	1.27	1.14	1.76	1.71
Winder[2]	1.30	1.16	1.90	1.67

[1] Plain and dobby looms.

[2] Automatic spooler.

SOURCE: Bureau of Labor Statistics.

The rise in hourly earnings and the longer workweek raised average weekly earnings for production workers in textile mills to $82.12 in 1966 compared with $57.96 in 1957. Compared with the all-manufacturing average, however, textile earnings are still relatively low. In 1966, average weekly manufacturing earnins were 37 percent above textile earnings; in 1957, they were 40 percent greater. In the early postwar years, the relative differential was considerably less-about 20 percent.

Fringe benefits are also increasing, but are still relatively low compared to payments in manufacturing. According to Department of Commerce estimates, supplements to wages and salaries (including employer contributions for social insurance, private pension and welfare funds, medical compensation, military reservist pay) more than doubled between 1957 and 1966. The ratio of supplements to total compensation (wages and salaries and supplements) rose from 6.2 percent in 1957 to 9.0 percent in 1966, about two and a half times the 1947 ratio. In all manufacturing, supplements constituted 12.0 percent of total compensation in 1966. (See table 33.)

Another way of measuring the changes in the structure of compensation is in terms of payroll expenditures for supplementary employer practices. In 1962, 8.3 percent of the gross payroll for production workers in the textile industry was paid out for: leave time (3.7 percent), premium pay for overtime, weekend, holiday, and shift work (4.0 percent) and Christmas and related bonuses (0.6 percent). The all-manufacturing group spent 10.9 percent of its gross payroll on these practices, the difference resulting largely from substantially higher ratio of paid leave than in textiles. In addition, private welfare plans in textiles cost 2.9 percent of the industry's gross payroll in 1962, compared with 5.4 percent for all manufacturing. The textile industry paid out 6.0 percent of its gross payroll for Social Security, Unemployment Compensation, and related legally required programs,

Table 33. Compensation of Employees in Manufacturing and Textile Mill Products Industry, 1947 and 1957-66

(In millions of dollars)

Year	Total compensation		Wages and salaries		Supplements[1] to wages and salaries		Supplements as a percent of total compensation	
	Manufacturing	Textiles	Manufacturing	Textiles	Manufacturing	Textiles	Manufacturing	Textiles
1947	$44,537	$3,219	$42,500	$3,103	$2,037	$116	4.6	3.6
1957	90,089	3,497	82,482	3,280	7,607	217	8.4	6.2
1958	86,242	3,318	78,682	3,116	7,560	202	8.8	6.1
1959	95,776	3,722	86,895	3,464	8,881	258	9.3	6.9
1960	99,424	3,708	89,712	3,445	9,712	263	9.8	7.1
1961	99,718	3,663	89,823	3,396	9,895	267	9.9	7.3
1962	108,158	3,906	96,662	3,607	11,496	299	10.6	7.7
1963	112,888	3,950	100,606	3,635	12,282	315	10.9	8.0
1964	120,463	4,212	107,166	3,879	13,297	333	11.0	7.9
1965	130,312	4,616	115,570	4,239	14,742	377	11.3	8.2
1966	145,495	5,084	128,052	4,625	17,443	459	12.0	9.0

[1] Represent compensation not commonly regarded as wages and salaries. Consist of employer contributions for social insurance, employer contributions to private pension and welfare funds, compensation for injuries, directors' fees, pay of the military reserve, and other minor items of labor income.

SOURCE: Department of Commerce.

compared with 5.8 percent for all manufacturing. (Table 34.) The textile industry had a higher ratio of expenditures to payrolls for the legally required insurance programs, in part because the Social Security scale of rates was applicable only to earnings up to $4.800 with no higher rates above that level.

Table 34. Employer Expenditures for Selected Supplementary Practices for Production and Related Workers in Manufacturing and Textile Mill Industries, 1959 and 1962

Selected supplementary remuneration practices	Manufacturing				Textile mill products			
	Percent of gross payroll		Cents per plant man-hour		Percent of gross payroll		Cents per plant man-hour	
	1959	1962	1959	1962	1959	1962	1959	1962
Total	-	-	48.2	56.7	-	-	25.9	31.0
Paid leave	6.0	6.0	14.3	15.4	3.6	3.7	5.9	6.6
Premium pay	4.3	4.2	10.3	10.8	4.1	4.0	6.8	7.2
Legally required payments	4.5	5.8	10.7	14.8	4.9	6.0	8.2	10.8
Private welfare plans	5.4	5.4	12.9	13.9	3.0	2.9	5.0	5.3
Bonuses	(1)	.7	(1)	1.8	(1)	.6	(1)	1.1

1 Private welfare plans include bonuses in 1959. Bonuses primarily made under profit-sharing plans were excluded in 1959; included in 1962.

SOURCE: Bureau of Labor Statistics

The proportion of textile workers receiving supplementary benefits vary widely by region and are more extensive in Northern union-affiliated mills. Medical insurance, for example, covered about two-fiths of the cotton broadwoven workers in the Southeast, compared with nearly all workers in New England in 1965. Nearly all cotton textile workers in New England received six paid holidays annually, whereas less than half of the workers in the Southeast were paid for holidays, most commonly 2 days a year. Plans providing lump-sum payments at retirement applied to nearly all cotton workers in New England but were virtually nonexistant in the South. On the other hand, pension plans providing regular payments for the remainder of the retiree's life applied to over half of the workers in the Southeast (a large proportion were covered by profit sharing plans) but were rarely reported in New England.

Adjustments to Technological Change

Formal programs to assist workers to adjust to technological change are found primarily in plants with union agreements and even these are few in number . Such provisions are found more frequently in contracts covering Northern mills than in Southern mills. Contract provisions regarding internal labor adjustments, such as workload changes, are fairly prevalent, but provisions for regulating or easing layoffs are very limited.

Unions in the textile industry believe that changing technology is inevitable and, in the long run, beneficial to the industry's growth, but that such changes can be made in an orderly way to protect the job security and working conditions of employees. Bargaining agreements recognize management's prerogative to institute technological change, but in many cases, attach various qualifications. A general statement of the intent of one major contract, relative to technological change, provides that management may

> "...change or introduce machines, processes and methods of manufacture for the purpose of insuring efficient operation and utilizing the employees' working time most productively and without adversely affecting the workers' physical and mental condition or causing undue fatigue."

Procedures established by provisions for adjustment to technological change in contracts covering 1,000 employees or more are described below. However, the extent to which these provisions are operable or successful is difficult to assess. Labor-management relations differ from mill to mill. Moreover, custom and common sense often dictate adjustments not formally provided for in the contract.

Advance notice. Many contracts require some type of advance notice by the company to its employees and union of changes in job procedures and assignments. One major contract, for example, reads:

> "It is the responsibility of the Company, when making changes in job procedures and assignments, to inform the employees affected in advance of such changes so that they will have a full understanding of the work to be performed and the methods to be used at least two weeks prior to the new or changed work procedures."

Later, in the same contract, there is a provision for advance notice to the union, more specifically tied to technological changes. It also provides for discussion by union and management on the proposed change, a provision less frequently included in textile bargaining agreements.

> "Management shall first inform the Union of the fact that a change is to be made, of the approximate date of its installation, the nature thereof, proposed duties and job assignment...The parties shall meet and discuss the proposal at least two weeks before the day fixed for the institutions of such change. The mill will furnish all information which is necessary to a complete understanding of the proposed change."

A fairly large proportion of bargaining agreements reviewed, covering 1,000 textile employees or more, provide for a trial period for the proposed change, and procedures for negotiations regarding permanent installation. One major contract contains the following provision:

> "The mill may install the proposed change for a trial period of four weeks which may be extended by mutual agreement... Within fifteen days of the expiration of the trial period, the Union, if dissatisfied, may present a written statement of its grievances, and if the same shall not be satisfactorily adjusted by negotiations between the

> parties within five days thereafter, the matter may be submitted by the Union to arbitration for final and binding decision."

Workload Adjustments. In unionized mills, technological changes which affect the pace of work--"speedup" (i.e., installing faster machines or speeding up old machines) and "stretchout" (i.e., increasing the number of machines assigned to the worker)--are often a major topic of labor-management discussion. Labor's objection to speedup and stretchout are traditional, predating union involvement, and stem from workers' fear of loss of jobs, since each worker's output increases with the increase in the number or speed of machines tended.

In some contracts, workload assignments are subject to review by the union and may be submitted to arbitration. A sample of this type of provision follows:

> "Existing workloads or work assignments shall not be changed except by mutual agreement of the employer and the local union....Work assignments shall not be interpreted to mean production quotas or machine speed....During this thirty day period (of advance notice) the Employer and the Union shall confer for the purpose of determining the manpower complement and work assignments."

If no agreement can be reached, this may be submitted to arbitration. In some contracts, however, no formal provisions are made for grievance procedure regarding change in work assignments. One such contract states:

> "In expanding and contracting the number of looms, sides, machines, etc. to which an employee is assigned, it will be done in such manner as in the discretion of the company will result in the most efficient operation of the mill. Such changes will be discussed with the union."

Transfer Rights and Retraining. Bargaining agreements in the textile industry do not generally make provision for transfer rights to another department or another mill in the event of displacement due to technological changes. In actual practice, however, an effort is often made to avoid layoff through transfer, if possible. However, since seniority is usually on a department basis, transfer to another department is possible only if there are no outstanding laid-off workers from the department awaiting recall. Transfer from one department to another usually results in a loss of seniority in the old department after a trial period.

Training or retraining provisions are included in only a few textile agreements. One contract, for example, requires that "whenever management makes a change in job assignments involving any change of technique or departure from current practices, management will provide instruction for the employees involved...." Another contract sets up a 4-year apprentice job program with the objective of "training younger people of proven ability for further promotion to skilled and supervisory jobs." Probably the most extensive training provisions are included in a contract between the Knitted Outerwear Manufacturers Association and the International Ladies' Garment Workers' Union which establishes a trust fund financed by employers, one aspect of which is the development of training programs.

Under the Manpower Development and Training Act and the Area Redevelopment Act, the Federal government has financed institutional and on-the-job training programs for underemployed and unemployed workers for existing job vacancies in textile mills in several localities. These programs include former textile workers but are not limited to them, and no data are available on the proportion of trainees who were previously in the textile industry. Between August 1962, when the MDTA program began, and December 1966 about 4,200 workers were trained for many textile occupations. Occupations for training are determined on the basis of current local requirements. The number of trainees and the duration of training in occupations with over 100 trainees are presented in the following table:

Occupation	No. of trainees	Duration of training (weeks)
Weaver	1,157	5-39
Loom fixer	476	9-52
Spinner	440	4-30
Knitting machine operator	336	4-26
Doffer	282	5-20
Laborer	276	4
Thrower	266	4-52
Yarn winder	106	4-20
Other	745	4-50

Labor shortages for particular occupations in some plants and localities continue to require training programs in spite of the prospect of declining employment for those occupations in the industry as a whole. This applies particularly to laborers.

Layoff and Recall. Collective bargaining agreements usually provide for the principle of seniority as a measure of protection for the employee displaced by technological developments or other causes for which he is not responsible. In contracts in which occupational seniority by department governs layoffs and recalls, a typical provision states:

> "In cases of lay-offs, the last one in shall be the first one out, and in cases of recall, the last one out shall be the first one in."

In such contracts, seniority lists may be subject to grievance by the union. One major contract requires:

> "Any grievance with respect to any (seniority) list shall be submitted to the Company within thirty days after the list shall have been furnished to the Union."

If it is not settled, it may be submitted to arbitration in accordance with relevant contract provisions.

However, various limitations on seniority rights regarding layoff and recall are included in many contracts. One contract states that an employee who has completed his "probationary period" need not

> "be considered a permanent or steady employee.. where technological changes within a department have created an excess of manpower... or reduced the need for manpower."

Another example of a seniority clause states:

> "In cases of layoff or reemployment, when ability is equal, seniority shall govern."

In one contract, the principle of last in-first out applies in all cases of layoff except in the following:

> "Incentive workers with less than 5 years seniority who during the 90 day period of normal operations preceding layoff, have earned, on an average, less than their base rate, shall be laid off....before all other employees in their occupational group."

Income Maintenance. Severance pay and supplemental unemployment benefit plans which alleviate the economic hardships of layoff are very limited in textile bargaining agreements, particularly in southern mills.

Severance pay is generally intended to provide financial assistance to tide workers over a period of unemployment. It usually involves complete severance of the employment relationship including loss of seniority. Of 28 major (1,000 employees or more) textile agreements reviewed in 1963, 11 (covering 36.2 thousand workers) contained some provision for a severance pay or layoff benefit plan, about the same ratio of contracts as in all manufacturing. However, minimum service requirements are considerably more stringent in textiles. Half of the textile contracts having severance plans required more than 5 years service. This length of service was stipulated in about 2 percent of all manufacturing contracts providing severance payments. In the textile contracts, 25 percent required only one year or less, whereas half of all manufacturing contracts had these low minimum service requirements.

Of the eleven textile contracts with severance pay plans, several provide that retirement is the only condition under which severance pay is granted. This was often the only benefit available upon retirement. Such a provision is very infrequent in other industries. One textile contract states:

> "The employer will pay retirement separation pay to each of its employees who, having attained the age of 62, voluntarily retires from active employment in the mill...."

Only a few contracts specify technological displacement as the condition for severance pay:

> "Any employee permanently displaced because of technological reasons, i.e., change in plant or equipment or changes in process operations, either of which causes the particular job to be permanently abolished shall receive severance pay...."

One type of contract pays severance benefits upon business termination. A fund established by the International Ladies' Garment Workers' Union (ILGWU) and employer associations in the knitting industry provides for a lump-sum payment to be made to workers who are laid off because of plant closings. If the terminated worker has been in continuous employment with the employer for at least 9 years and if he is continuously unemployed for 1 year, he then becomes eligible for a second lump-sum payment equal to his original termination payment.

Supplemental unemployment benefit (SUB) plans, another type of income maintenance, usually provide weekly allowances to workers, who were temporarily laid off, to supplement their unemployment compensation benefits. The only SUB plan in major textile agreements is provided in the ILGWU contract referred to above. In addition to the separation payment, this agreement provides a weekly supplemental unemployment award. Unlike SUB provisions in other industries, payments are only available in the event that an employer permanently terminates his business.

Outlook. Compared with other industries, the textile industry has relatively few formal institutions to handle problems of worker displacement because of technological change. The outlook is for relatively little improvement in this situation. Because of the continued possibility of plant closings in some localities and sectors of the industry, government institutions for unemployment compensation, placement services, training and retraining, etc., may play an increasingly important role.

Appendix Tables

Table A-1. Corporate Internal Funds and Total Expenditures for plant and Equipment 1947-66

(Million of dollars)

Year	Internal funds[1]	Expenditures for plant and equipment[2]
1947	$833	$510
1948	805	620
1949	356	470
1950	646	450
1951	436	530
1952	268	430
1953	299	380
1954	235	330
1955	436	370
1956	461	460
1957	426	410
1958	406	290
1959	589	410
1960	516	530
1961	525	500
1962	617	610
1963	634	640
1964	759	760
1965	893	980
1966	[3]923	1,130

[1] Undistributed corporate profits and corporate capital consumption allowances (depreciation charges and accidental damage to fixed capital).

[2] Corporate and noncorporate.

[3] Preliminary.

SOURCE: Department of Commerce and Securities and Exchange Commission.

Table A-2. Age of Equipment of Large Companies, Manufacturing and Textile Mill Products, 1962 and 1966

(Percent installed)

Year	More than 16 years	11 to 16 years	6 to 10 years	5 years old or less
Spring 1962:				
Manufacturing	24	16	27	33
Textile mill products	32	17	24	27
December 1966:				
Manufacturing	24	19	21	36
Textile mill products	29	18	15	38

SOURCE: McGraw-Hill Publications, Department of Economics.

Table A-3. Employment in Textile Mill Products Industry, 1947-66

(In thousands)

Year	All employees	Production workers
1947	1,299.0	1,220.0
1948	1,332.0	1,248.0
1949	1,187.0	1,103.0
1950	1,256.0	1,169.0
1951	1,237.7	1,146.2
1952	1,163.4	1,073.2
1953	1,154.8	1,063.9
1954	1,042.3	953.2
1955	1,050.2	961.6
1956	1,032.0	944.3
1957	981.1	893.3
1958	918.8	832.5
1959	945.7	857.4
1960	924.4	835.1
1961	893.4	805.0
1962	902.3	812.1
1963	885.4	793.4
1964	892.0	798.2
1965	921.3	823.1
1966	961.5	848.0

SOURCE: Bureau of Labor Statistics.

Table A-4. Regional Distribution of Textile Employment, 1947, 1954, and 1963

(Percent of total)

Region	1947	1954	1963
Total employment	100.0	100.0	100.0
New England	22.9	16.3	11.7
Middle Atlantic	23.7	20.0	17.0
South Atlantic	39.3	48.8	56.5
Other	14.1	15.0	14.7

NOTE: Because of rounding, sums may not add to 100.0.

SOURCE: Bureau of the Census.

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